Instruction Manual

SyCore / PC104

- Manual Release V 6.11 -

Serial No.: UO467 12/0 0613

The manufacturer can not be held liable for incorrect statements and their consequences; subject to change !

1. General Instructions **3**
2. Safety **3**
3. SyCore **3**
3.1. Front Panel 4
3.2. Rear Panel 5
3.3. Operation 6
4. Oscillators **10**
4.1. Function Diagram 10
4.2. Generation of Low-Frequency AC Voltages 11
4.3. Generation of High-Frequency AC Voltages 11
4.4. Basic Adjustment 11
4.5. Basic Functions 12
4.6. Flicker Simulation (in Connection with Opt. „Multiplier“) 16
4.7. Special Functions 17
5. Measurement **22**
5.1. RMS 22
5.2. Frequency Measurement 28
5.3. Oscilloscope 29
6. Control **31**
6.1. Amplifier 31
6.2. Enhanced Amplifier Functions 32
6.3. Parallel Connection (optional) 33
6.4. Impedance (optional) 34
6.5. Current Limitation (optional) 35
6.6. Resistor Load (optional) 36
6.7. Amplifier Selection (optional) 37
6.8. Safe Communication with Amplifier (optional) 38
7. Macros **39**
7.1. Execute Macros 39
7.2. Store Macros 39
7.3. List Macros 39
7.4. Load Macros 40
7.5. Save Macros 40
7.6. Overwrite Macros 40
8. Set-up **42**
8.1. Adjustment of the Interface address 42
8.2. Info 42
9. IEEE488 Interface **43**
9.1. Command Syntax 43
9.2. Command Synchronization 44
9.3. List of Commands 45
9.4. Oscillator 48
9.5. Page Control List 77
9.6. Measurement 96
9.7. Control 105
9.8. Input-/Output Port (optional) 121
9.9. Interface 123
10. Pin Assignment **130**
10.1. Link In/Out 130
10.2. IEEE488 131
10.3. Control 132
10.4. Analog I/O 133
10.5. RU_Control 133

10.6. Digital I/O (Event Trigger) 134
11. Technical Data **137**
11.1. Oscillator 137
11.2. Multiplier 138
11.3. Measurement 138
11.4. General 140
12. Index **141**
13. Annex **144**

1. General Instructions

This device has been shipped in perfect safety condition. However, it has to be checked for mechanical defects before the first start-up. If there is any transportation damage, please inform Spitzenberger & Spies immediately. In that case the device shall not be put into operation before contacting Spitzenberger & Spies and getting instructions how to carry on.

Reference: **To avoid malfunctions the default values must only be changed by Spitzenberger & Spies service technicians ! Exception: IEEE address.**

2. Safety

The device must only be operated by instructed personnel !

Energized parts might be uncovered when opening the housing. Before opening the device the mains input cable has to be disconnected from the supply voltage due to safety regulations. The chassis ground of the device is connected to earth.

3. SyCore

SyCore (system core) is an all-round control and measurement device. Similarly to a computer it is able to undertake several functions.

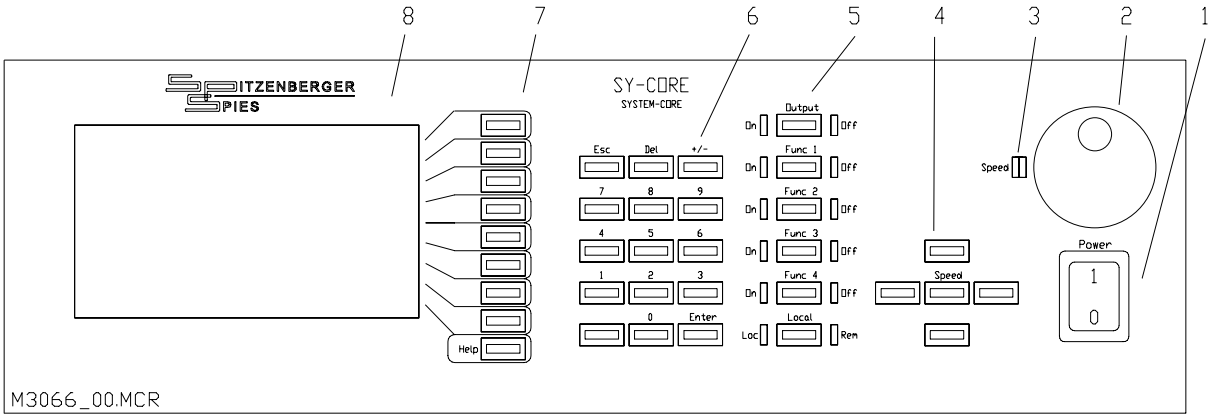
- device control unit (for voltage and current amplifiers)
- oscillator unit (for voltage and current amplifiers)
- measurement unit (for voltage and current amplifiers)

The firmware of the device supports the following options:

Device option	**Function in the menu**
One oscillator card	Oscillator
Two oscillator cards	Oscillator
Multiplier	Oscillator | Trig/Sync/Add/Mult
Measuring card	Measurement
Current limit card	Control | Current Limit
Amplifier	Control | Amplifier
Impedance	Control | Impedance
Parallel Connection	Control | Parallel Conn
Resistor Load	Control | R-Load

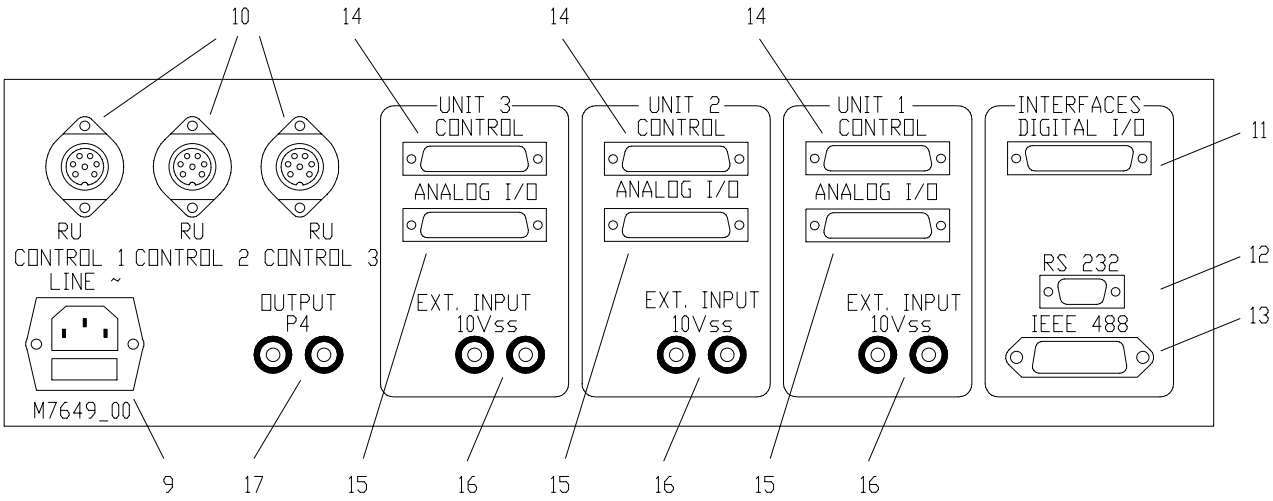
Caution: **The functions must only be performed when the referring options available, otherwise malfunctions might occur.**

3.1. Front Panel



Pos.	Lettering	Component	Function
1	POWER	Tumbler switch	Mains switch for switching on and off the device
2		Incremental switch	Manual tuning of frequency, voltage etc.
3	SPEED	Indication	Yellow: high resolution of the incremental switch (small steps) Green: low resolution of the incremental switch (large steps)
4		Speed keys	Resolution of the incremental switch
		Cursor keys	Menu selection
5	OUTPUT ...	Function keys	e.g. output on/off
		Indication	On (red): the output is switched on Off (green): the output is switched off Both LEDs (red + green): at least one amplifier is overload
6	ESC, DEL ...	Numeric keyboard	Input
7	HELP	Soft-keys	Menu direct switching
8		Display	for indication of the menu, setting values and measured values

3.2. Rear Panel



Pos.	Lettering	Component	Function
9	LINE ~	Rubber connector for non-heating apparatus with 1A fuse	Mains supply
10	RU_CONTROL	Connector socket series 692/6+PE	Mains control (additional device e.g. amplifier type PAS)
11	SPS	Socket 25-pole SUB-D	Interface SPS with trigger assignment
12	RS232	Not fitted	
13	IEEE488	Micro Ribbon 24-pole type Ansley	IEEE-488-socket
14	CONTROL	Plug 25-pole SUB-D	Control output
15	ANALOG I/O	Socket 25-pole SUB-D	Signal input/output
16	EXT. INPUT	Safety lab socket	External input (1), (2) Input impedance approx. 10kΩ
17	OUTPUT P4	Safety lab socket	Oscillator output 4th phase (1)

(1) Input and Output signals are related to earth. In order to avoid beat or similar resulting from GND loops you are recommended to use an unearthed function generator (laboratory: an external generator with isolation transformer may be used).

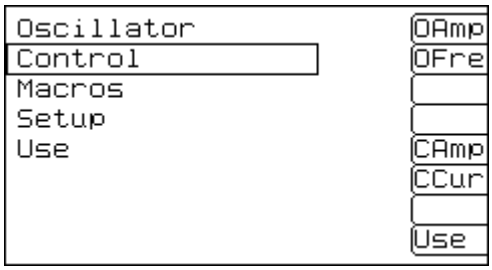
(2) The external input is designed as adder input to the internal oscillator/oscillators. Harmonics can be easily generated with this adder input. The adder function is continuously available and therefore doesn´t need to be enabled.

Reference: The above shown front and rear panel diagrams and descriptions contain all components and options available for the device.

3.3. Operation

3.3.1. Display Design

After starting the device you can see a menu sequence at the left and a „soft-key“-sequence at the right side (to be operated with the keys (7)).



3.3.2. Display Contrast

For changing the contrast of the display please act as follows:

- Press the help-key
- Press the cursor-right-key or turn the incremental switch to the right to increase the contrast
- Press the cursor-left-key or turn the incremental switch to the left to decrease the contrast.
- Leave the help-menu with ESC or Enter
- If you want to store the adjustments go to Set-up, Save and Yes in the menu.

3.3.3. Menu Sequence

The menu sequence indicates the designations of the menu available.

3.3.3.1. Opening a Menu

For opening a menu move the cursor by means of UP and/or DOWN or with the incremental switch to the requested menu and press *Enter*.

3.3.4. Softkeys (Status Sequence)

The status sequence indicates the designations of the available dialog windows or functions.

3.3.4.1. Open a Dialog Window or a Function

For opening a dialog window or a function, press the corresponding key right beside the status sequence.

3.3.5. Dialog Window

The dialog window indicates the available input panels and switch panels.

3.3.5.1. Input Lines

At the input panel for example a voltage value can be adjusted.

- By means of the numeric keys you can input a value.
- With +/- you can change the sign of a value.
- With *Right* and *Left* you can move the cursor in the input panel.
- With *Del* you can delete a figure above the cursor.
- With *Esc* the original value will be indicated again.
- With *Enter* the value will be accepted.
- With the incremental switch you can change a value incrementally (+) or decrementally (-).

3.3.5.2. Radio Buttons

With the radio buttons a switch can be selected.

- With *Right* and *Left* you can move the cursor.
- With the numeric keys 1 ... 9 the buttons can be selected directly; 1 is the first button, 2 is the second button et cetera .
- With *Esc* the original switch will be indicated again.
- With *Enter* the switch will be accepted.
- With the incremental switch you can move the cursor.

3.3.6. Description of the Keys

3.3.6.1. Edit Keys

Esc	indicates the origin value or leaves the menu and the dialog window
Del	deletes figures above the cursor
+/-	changes signs of a number
Enter	accepts input lines, radio buttons and dialog window

3.3.6.2. Cursor Keys

▲	*Up*	changes selection between input lines, radio buttons and menu points
▼	*Down*	changes selection between input lines, radio buttons and menu points
►	*Right*	changes selection of radio buttons
◄	*Left*	changes selection of radio buttons

3.3.6.3. Digital Keys

0 ... 9

- Decimal point

3.3.6.4. Function Keys

Output	Output on/off
Func1	Impedance on/off
Func2	Inrush current source on/off
Func3	not fitted
Func4	Status indication current limit via LED (push-button without function)
Local	Local / remote control

3.3.7. Menu Tree

- Oscillator
  - Amplitude/Angle
  - Frequency
  - A/AF-Pulse
  - F-Pulse
  - Trig/Sync/Add/Mult
  - Function
  - Memory
- Measurement
  - Rms
  - Frequency
  - Oscilloscope
- Control
  - Amplifier
  - Amplifier Enh
  - Parallel Conn
  - Impedance
  - Current Limit
  - R-Load
- Macros
  - Run
  - Record
  - List
  - Load
  - Save
  - Delete
- Setup
  - Interface
  - Info
- Use

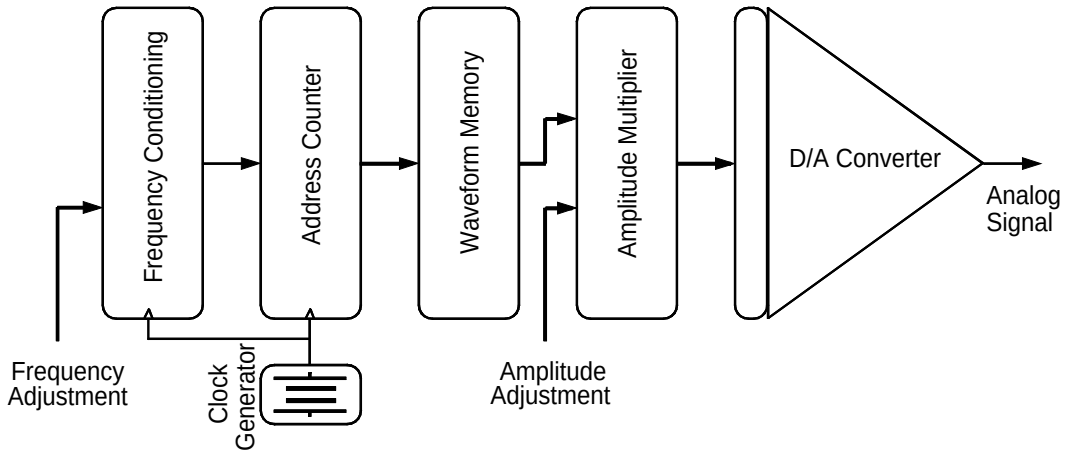
4. Oscillators

Several arbitrary waveform generators are available. For the utilisation of the all functions of these generator, a certain basic knowledge on the way of function is required. If you want to use only the standard functions for the time being, you can overleap the following section "**Function Diagram**".

4.1. Function Diagram

The main components are:

- frequency-stable clock generator (10MHz)
- frequency conditioning (17bit divider)
- address counter (up to 1Mbyte)
- waveform memory (RAM up to 1Mbyte)
- amplitude multiplier (for each channel/phase)
- analog/digital converter (DAC; for each channel/phase)



The requested waveforms (sine, delta, square-wave, pulse, ramp or even free-programmable mixings of harmonics and subharmonics) are stored in the waveform memory. An address counter reads the digital values (16 bit values = ±32767) out of this waveform memory.
In the amplitude multiplier the requested voltage will be adjusted (16 bit 4-quadrant product of waveform and amplitude adjustment).
This multiplied value is converted to the analog control signal via a digital/analog converter.
The frequency conditioning defines the speed to read the waveform (frequency). During multiphase operation, the single-phase signals are generated in time-division multiplex procedure. Therefore, the maximum frequency decreases proportionally to the number of phases.

4.2. Generation of Low-Frequency AC Voltages

When generating low-frequency AC and DC voltages high-quality waveform is more important than the output speed. Therefore we recommend to select higher memory-depths (1k, 4k or 16k) to achieve a better harmonic distortion when using power engery frequencies (16 2/3Hz, 50Hz, 60Hz, 400Hz).

When using multi-phase systems the phase number has to be adjusted to a value >1. Thus, the maximum possible output frequency is reduced but then again the frequency resolution is increased (see table in section 4.7.4).

4.3. Generation of High-Frequency AC Voltages

When generating high-frequency AC voltages (kHz-range, e.g. EV amplifiers) high output speed is important while the waveform quality is inferior. A higher harmonic distortion is secondary because the amplifier can´t transmit high-frequent components of the signal. Therefore, you should select lower memory depth for the generation of higher frequencies (256, 1k).

For additional increasing of the maximum output frequency several periods of one signal can be written into the 256-point memory. Furthermore the phase number of the oscillator should be set to 1 (if possible). Please see section 4.7.4

4.4. Basic Adjustment

The amplifier is set to the following basic adjustments:

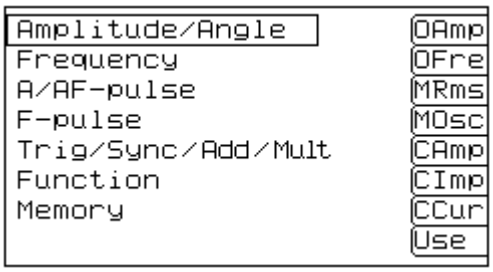
Oscillator:

- Amplitude: 0% for each phase
- Phase angle: 0° phase 1; 120° phase 2; 240° phase 3; 0° phase 4
  (only at 4-phase version, at less phases reduced corresponding)
- Frequency: 50Hz
- Trigger: 0°
- Synchronisation: Out
- Function: Sine for each phase
- Memory depth: 1k (1024 points)

Oscillator type	**1Kbyte**	**64Kbyte**	**1024Kbyte**
Memory depth	1024	1024	1024
Start address Phase 1	0	0 (Page 1)	0 (Page 1)
Start address Phase 2	0	16384 (Page 17)	262144 (Page 257)
Start address Phase 3	0	32768 (Page 33)	524288 (Page 513)
Start address Phase 4	0	49152 (Page 50)	786432 (Page 769)

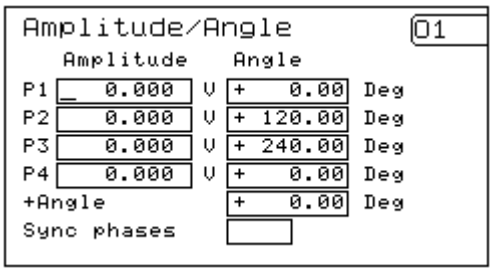
4.5. Basic Functions

Open the menu **Oscillator**. The display shows:



4.5.1. Amplitude and Phase Angle

Select **amplitude/angle.** The **amplitude** menu appears:



4.5.1.1. Amplitude

Go to **Amplitude** with the cursor keys, set the amplitude and press *Enter*.

The amplitude is set at the adjusted trigger angle. The trigger angle refers to a virtual phase 0.

4.5.1.2. Angle

Go to **Angle** with the cursor keys, set the angle and press *Enter*.

The phase angle is set to the adjusted trigger angle. The trigger angle refers to a virtual phase 0.

4.5.1.3. + Angle

Go to **+Angle** with the cursor keys, set the angle and press *Enter*.

This value is added to angles of the phases 1 – 4.
If e.g. 90 is set the following angles result:
P1=0+90, P2=120+90, P3=240+90.

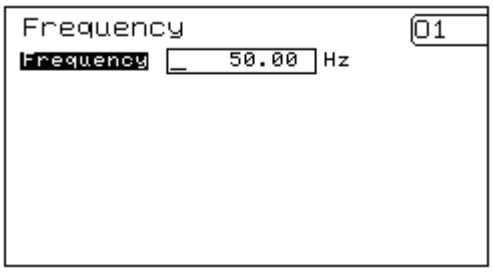
4.5.1.4. Synchronized Amplitude Phases

Go to **Sync Phases** with the cursor keys, set the phases and press *Enter*.

The value Sync Phases indicates which amplitude phases are synchronized.
Adjust e.g. 123 to synchronize amplitude 1+2+3.

4.5.2. Frequency Adjustment

Select **frequency.** The **frequency** menu appears:

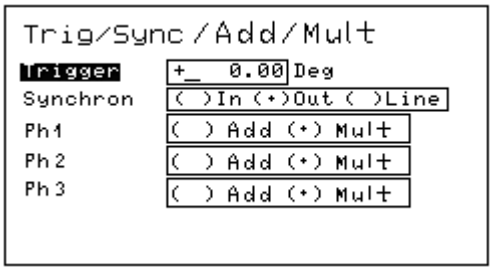


Go to **Frequency** with the cursor key, set the frequency and press *Enter*.

The minimum and maximum possible frequency and the resolution are linked to the adjusted memory depth and phase number. Closer information see section 4.7.4.

4.5.3. Trigger/Synchronous/Adder/Multiplier

Go to **Trig/Sync** with the cursor keys and press *Enter*.



4.5.3.1. Trigger

Go to **trigger** with the cursor keys, feed the **trigger angle** and press *Enter*.

The amplitude, the phase angle as well as the amplitude pulse are set at the adjusted trigger angle. The trigger angle refers to an internal virtual phase 0.

4.5.3.2. Synchronizing

Go to **synchron** with the cursor keys, select **in**, **out** or **line** and press *Enter*.

In: the oscillator is synchronised with the synchronizing pulse of the other internal oscillator.

Out: the oscillator sets the synchronizing pulse for the other internal oscillator.

Line: the oscillator is synchronised with line signal (only at option "mains synchronous"). If several oscillators are available all oscillators are set to **Line** in this operation mode.
Line shall only be adjusted when the adjusted frequency of the oscillator corresponds to the mains frequency because the correction angle at 50Hz and/or 60Hz refers always to the oscillator frequency.

Devices with 2 oscillators: When one oscillator is synchronized to the mains frequency and the second oscillator adds a signal with a higher frequency the right correction angle is only used when the oscillator synchronized to the mains frequency is adjusted to **Line**.

When the mains synchronisation is switched on solely the tests EN 61000-3-2/3/11/12 can be performed.

Reference: Never set all oscillators to **In** because this may cause undefined operation modes. When switching off the operation mode **Line**, firstly **Out** has to be set. Afterwards one of the oscillators can be set to **In** again.

4.5.3.3. Card Selection

Go to **Ph1, Ph2 oder Ph3** with the cursor keys, select **Add** oder **Mult** and press *Enter*. You can select the phases 1...3 variously.

Add:

SyCore with 1 Oscillator	SyCore with 2 Oscillators
The voltages of referring phase of the first oscillator and the external control voltage (sockets “ext. Input“) are added.	The voltages of the referring phases of both oscillators (1 and 2) are added.

Mult:

SyCore with 1 Oscillator	SyCore with 2 Oscillators
The voltages of the referring phase of the first oscillator and the external control voltage (sockets “ext. Input“) are multiplied.	The voltages of the referring phase of both oscillators (1 and 2) are multiplied.

4.6. Flicker Simulation (in Connection with Opt. „Multiplier“)

The following flicker simulations can be only conducted when the option „Multiplier“ is available“.

For the direct generation of sinusoidal or rectangular voltage fluctuations (flicker simulation) for simplification purposes a DC-voltage should additionally be added to the multiplicand.

Example:

Simulation of a sinusoidal flicker, 8.8Hz, 2% of nominal voltage. Please act as follows:

1. Switch on the multiplier:
   Menu „Oscillator“ - submenu „Trig/Sync/Add/Mult“
   For phase 1 select the adjustment „Mult“ in „Ph1“.
2. Select oscillator card 2
3. Set 230V amplitude at phase 1
4. Set 50Hz frequency
5. Select oscillator card 1
6. Change the waveform of phase 4 to DC
7. Set the amplitude of phase 4 to the maximum value (381.83V in range 270V).
8. Set the amplitude of phase 1 to 7,64V (381.83 * 2/100).
9. Set 8.8Hz frequency

Item 2…4 Adjustment of the nominal voltage.

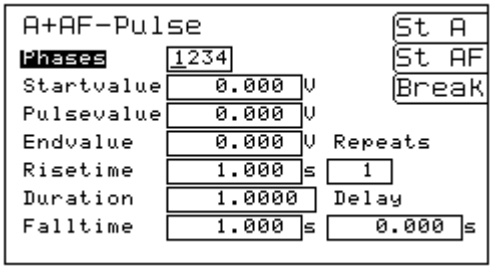
Item 6…9: Addition of a DC voltage with 100% amplitude (corresponds to factor 1) to the adjusted voltage change (item 8). Thus, the requested voltage fluctuation can be defined directly in the amplitude adjustment.

Reference: **When using integer values (item 9) of the basic frequency (item 4) we recommend to enable the synchronisation of the oscillators in order to avoid disturbances by beats.**

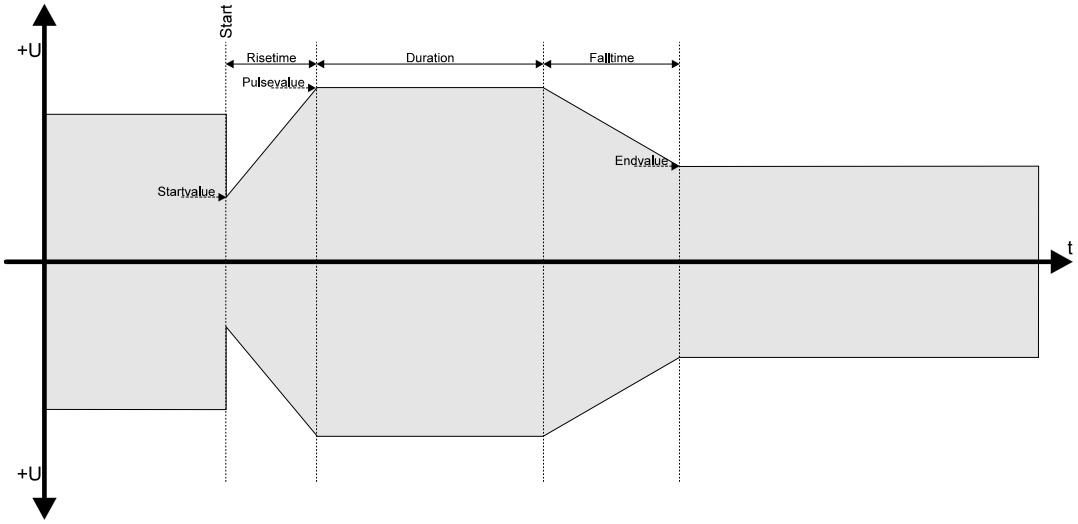
4.7. Special Functions

4.7.1. Amplitude Pulse

Go to **A/AF-Pulse** with the cursor keys and press *Enter*.



Example:

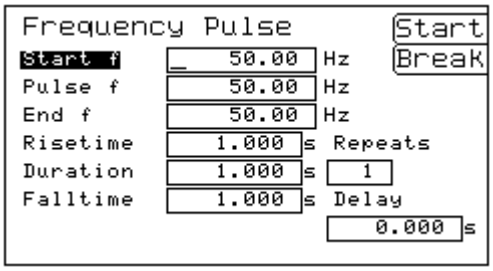


Reference: A loop is started when „0“ is input in the field „repeats“. This operation can be stopped by means of the key „break“.

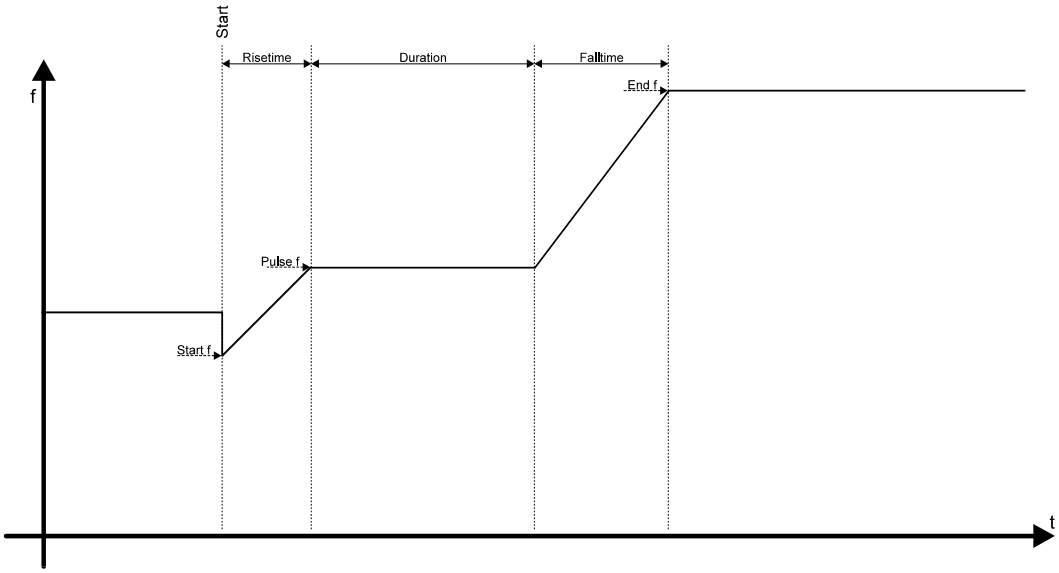
An amplitude pulse can be started by pressing the key **St A** after adjusting the values.
For the simultaneous starting of an amplitude- and frequency pulse (e.g. frequency sweep with simultaneous amplitude reduction) the key **St AF** has to be pressed after adjusting the frequency and amplitude values (adjustment of the frequency value please see section 4.7.2).

4.7.2. Frequency Pulse

Go to **F-Pulse** with the cursor keys and press *Enter*.

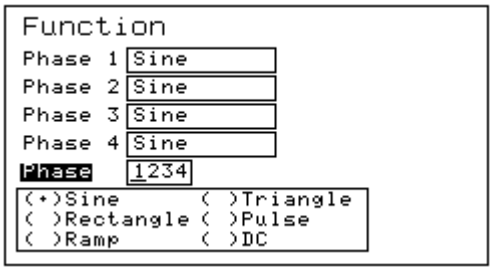


Example:

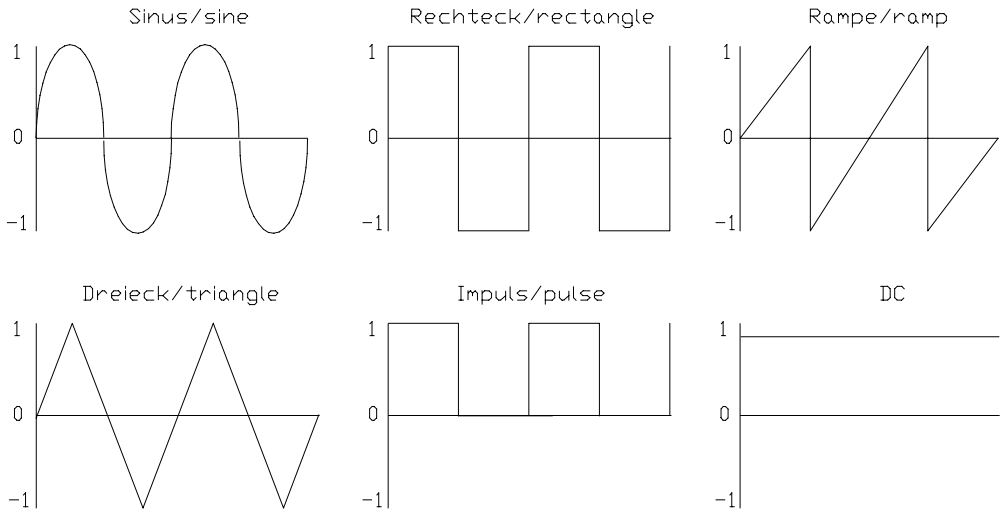


4.7.3. Waveform

Go to **Function** with the cursor keys and press *Enter*.



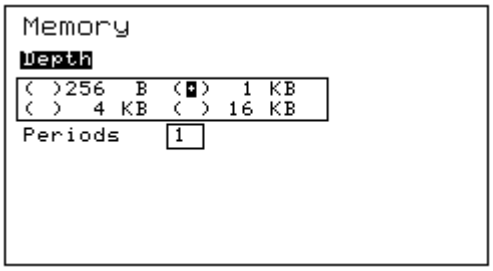
Example:



4.7.4. Memory Depth

Go to **Memory** with the cursor keys and press *Enter*. Here you can set the number of the digital resolution points per period.

Go to **Periods** with the cursor keys and press *Enter*. The frequency can be increased the multiple of the set period with this function.



Example: When setting 2 periods the maximum frequency doubles i.e. two periods are generated in the selected memory range (e.g. 1kB). The doubling of the signal frequency with the same output frequency is calculated automatically in the manual frequency input. Thus, subsequent frequency specifications result in the correct signal output frequency.

The lower the memory depth, the higher the maximum frequency; the lower the frequency resolution, the higher harmonic distortion and minimum frequency. A good compromise are the adjustments 1kB or 4kB. The number of the digital resolution points per period is equal to the memory depth. For detailed data please refer to the following table.

Phase number	Memory depth [B]	Max-Frequency [Hz]	Frequency resolution = Min.-Frequency [Hz]
1	256	39,062.50	0.298,023
1	1024	9,765.62	0.074,506
1	4096	2,441.40	0.018,626
1	16384	610.35	0.004,657
2	256	19,531.25	0.149,012
2	1024	4,882.81	0.037,253
2	4096	1,220.70	0.009,313
2	16384	305.18	0.002,328
4	256	9,765.62	0.074,506
4	1024	2,441.40	0.018,626
4	4096	610.35	0.004,657
4	16384	152.59	0.001,164
1	256 (2 Periods)	78,131.00	0.596,046
1	256 (4 Periods)	156,262.00	1.192,092

Attention: **Function, frequency and voltage have to be readjusted after every change of the memory depth.**

4.7.5. Angle Resolution

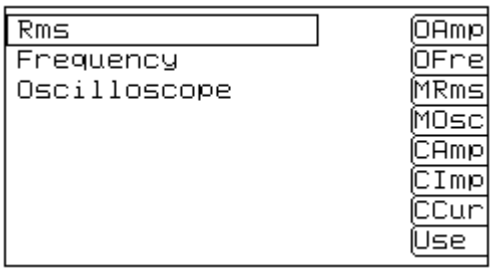
Attention: The lower the memory depth, the lower the angle resolution. The higher the memory depth, the higher the angle resolution. For detailed data please refer to the following table.

Depth	**A_{res}**
256	1.406,250
1,024	0.351,562
4,096	0.087,891
16,384	0.021,973

Depth = memory depth
A_{res} = angle resolution

5. Measurement

Open the menu **Measurement** (if available). The display indicates:



Reference: The description of the soft keys can be found in the sections 3.3.1 and 3.3.4.

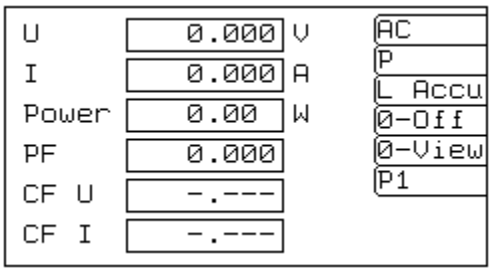
5.1. RMS

Go to **RMS** with the cursor keys and press *Enter*.

5.1.1. Voltage and Current Measurement

5.1.1.1. r.m.s. - Value Measurement (U/I)

AC-Mode

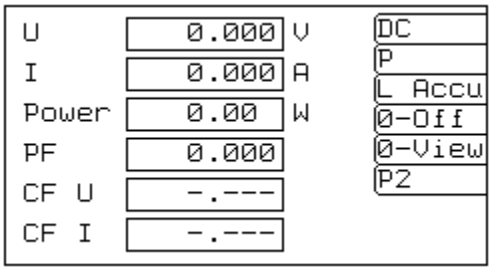


The r.m.s.-value can be determined as follows:

$$U = \sqrt{\frac{1}{T}\int_0^T u(t)^2\,dt} \qquad I = \sqrt{\frac{1}{T}\int_0^T i(t)^2\,dt}$$

The direct component is decoupled via a capacitor.

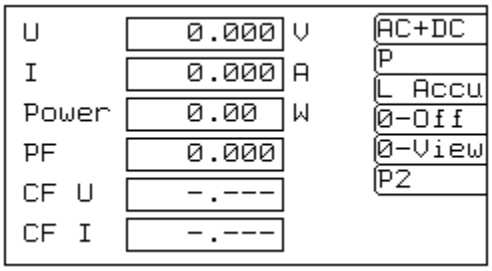
DC-Mode



The direct component for voltage and current is determined as follows:

$$U = \frac{1}{T}\int_0^T u(t)dt \qquad I = \frac{1}{T}\int_0^T i(t)dt$$

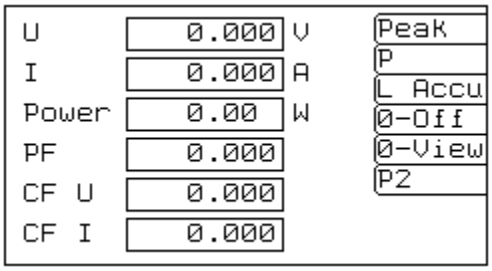
AC/DC-mode



During the AC+DC mode the direct component of a signal won't be decoupled. The voltage and current value is determined like during the AC-mode.

5.1.1.2. Peak Value (U/I) and Crest-Factor Measurement (CF U/CF I)

Peak mode



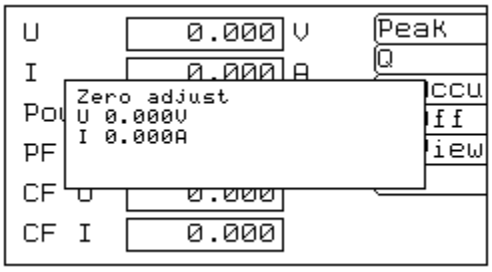
The peak value for voltage and current will be measured in the peak mode.

The crest factor for voltage and current is determined as follows:

$$CF_U = \frac{U_S}{U} \qquad CF_I = \frac{I_S}{I}$$

At the peak-value measurement the direct component of the measuring signal is not decoupled.

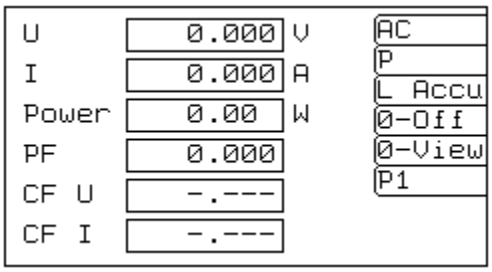
5.1.1.3. Offset Compensation



The DC offset of the measuring system will be compensated by this function. For this, the measuring inputs and/or the measuring lines, which go to the measuring object, will have to be short-circuited. After pressing the key ”S4” (0=off) a window with the DC offset of the measuring system appears for approx. 2s. The offset compensation is active as soon as the window goes out and the position of the key ”S4” switches to ”0=on”. During repeated operation of the key ”S4” the offset compensation switches off (0=off).

With the key ”S5” (view) you have the capability to indicate the finally-measured DC offset via a window which is faded in for approx. 2s.

5.1.1.4. Averaging Factor



Four different averaging factors can be adjusted via the key ”S3” (?-Accu). These factors specify the number of measurements to be averaged before the right measuring value is indicated. The higher the adjusted averaging factor, the longer the measuring duration.

L-Accu (Low): averaging via 1 measurement

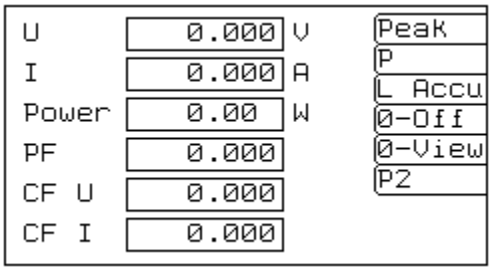
N-Accu (Normal): averaging via 8 measurements

M-Accu (Middle): averaging via 32 measurements

H-Accu (High): averaging via 128 measurements

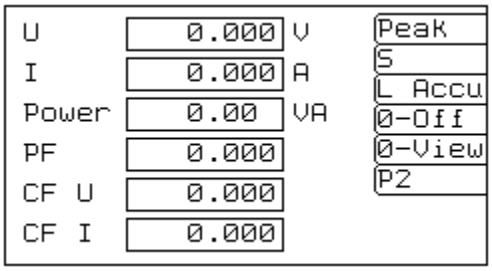
5.1.2. Power Measurement

5.1.2.1. Active Power (P)



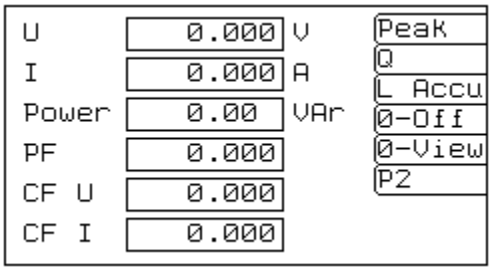
Press the key „S2“ to select P.

5.1.2.2. Apparent Power (S)



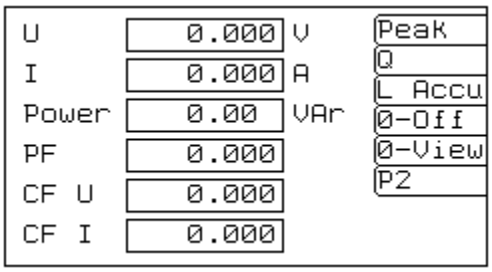
Press the key „S2“ to select S.

5.1.2.3. Reactive Power (Q)



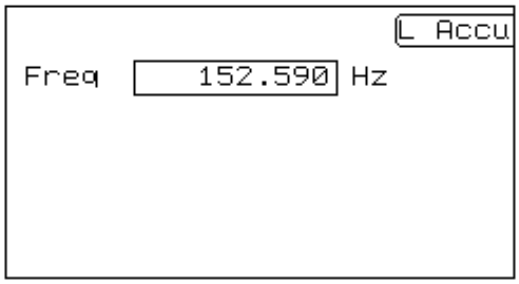
Press the key „S2“ to select Q.

Power Factor (PF)



5.2. Frequency Measurement

Go to **RMS** with the cursor keys and press *Enter*.



Four different averaging factors can be adjusted via the key ”S1” (?-Accu). These factors specify the number of measurements to be averaged before the right measuring value is indicated. The higher the adjusted averaging factor, the longer the measuring duration.

L-Accu (Low): averaging one measurement

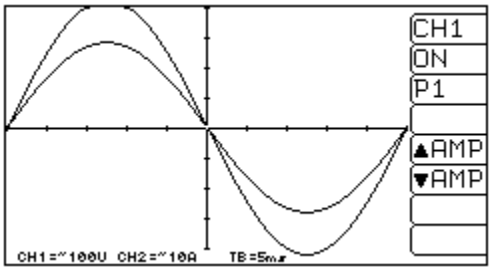
N-Accu (Normal): averaging eight measurements

M-Accu (Middle): averaging 32 measurements

H-Accu (High): averaging 128 measurements

5.3. Oscilloscope

Open the menu **oscilloscope**. The following is displayed:



5.3.1. Channel Adjustment

5.3.1.1. Channel Selection and Trigger Adjustment

Press the button ”S1” to select channel 1 or channel 2 or to get to the trigger adjustment. (**CH1**, **CH2** or **TRIG**).

All adjustments ”S2” to ”S7” refer to the selected channel.

5.3.1.2. Signal Representation

Press the button ”S2” to switch on and/or off the signal representation (**ON** or **OFF**).

5.3.1.3. Phase Selection

Press the button ”S3” to select the phase to measure (**P1**, **P2** or **P3)**.

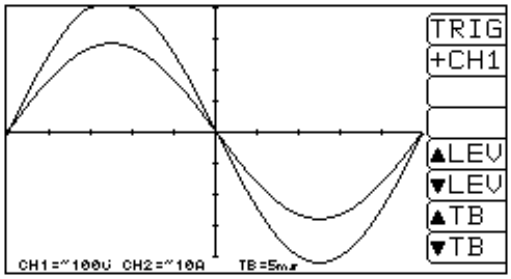
5.3.1.4. Amplitude Adjustment

Press the button ”S5” and/or ”S6” to adjust the amplitude of the signal representation (**ΔAMP** or **∇AMP)**.

5.3.2. Trigger Adjustment

Press the button ”S1” to select channel 1 or channel 2 or to get to the trigger adjustment. (**CH1**, **CH2** or **TRIG**).

All adjustments ”S2” to ”S7” refer to the trigger adjustment.



5.3.2.1. Edge Selection

Press the button ”S2” to select the edge and the channel to trigger on. **(CH1, -CH1, +CH2** or **-CH2**).

5.3.2.2. Trigger Level

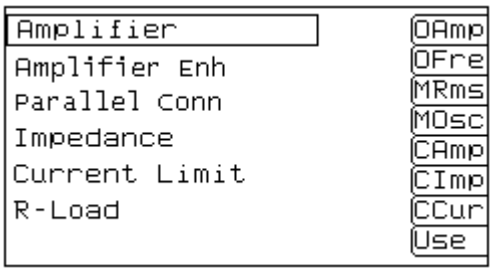
Press the button ”S5” and/or ”S6” to adjust the trigger level to trigger on (**ΔLEV** or **∇LEV)**.

5.3.2.3. Time Base

Press the button ”S7” and/or ”S8” to adjust the time base (**ΔTB** or **∇TB)**.

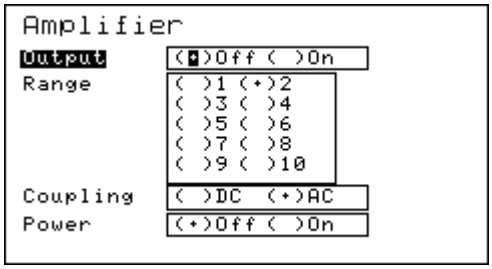
6. Control

Go to **Control** by means of the cursor keys and press *Enter*.



6.1. Amplifier

Go to **Amplifier** by means of the cursor keys and press *Enter*.



6.1.1. Output

For switching off and/or on the output go to **Output** by means of the cursor keys, select **Off** or **On** and press *Enter*.

See section 3.3.6.4 „Function keys“.

6.1.2. Range

Go to **Range** by means of the cursor keys, select the amplifier range and press *Enter*.

6.1.3. Operation Mode

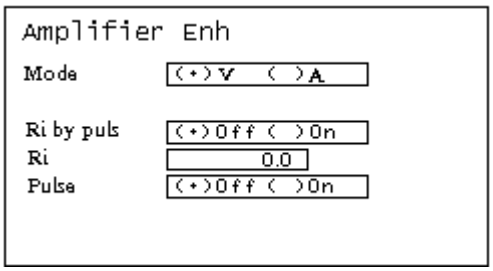
Go to **Coupling** by means of the cursor keys, select the **AC** or **DC** and press *Enter*. Leave the dialog with *Enter* to accept the adjustments. Leave the dialog with *Esc* to cancel the adjustments.

6.1.4. Supply

To switch off and/or on the device to be controlled (e.g. amplifier type PAS) go to **Power** by means of the cursor keys, select **Off** or **On** and press *Enter*.

6.2. Enhanced Amplifier Functions

Go to **Amplifier Enh** with the cursor keys and press *Enter*.



6.2.1. Operation Mode (optional)

Go to **Mode** with the cursor keys, select **V** for **Voltage Amplification** or **A** for **Current Amplification** and press *Enter*.

6.2.2. Internal Resistance at Pulse Output (optional)

Go to **RI by pulse** with the cursor keys, select **OFF** or **ON** and press *Enter*. Leave the dialog with *Enter* to accept the adjustments. Leave the dialog with *Esc* to reject the adjustments.

At the output of the amplitude pulse (A/AF-Pulse) or of the PCL the internal resistance is switched for the adjusted duration (A/AF-Pulse Duration).

6.2.3. Internal Resistance (optional)

Go to **RI** with the cursor keys, adjust the requested value and press *Enter*. Leave the dialog with *Enter* to accept the adjustments. Leave the dialog with *Esc* to reject the adjustments.

RI is the **value** of the internal resistance which is switched when the amplitude pulse or PCL is output.

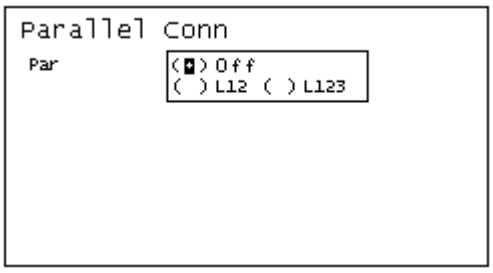
6.2.4. Pulse Operation (optional)

For switching on/off the pulse operation (switch power supply), go to **Pulse** with the cursor keys, select **Off** or **On** and press *Enter*.

The pulse operation has to be reset manually. Although the amplifier switches off the pulse operation automatically after approximately two seconds voltage distortions are possible. In any case a waiting period (a few seconds) is recommended to avoid overheating of the power supply.

6.3. Parallel Connection (optional)

Go to **Parallel Conn** with the cursor keys and press *Enter*.



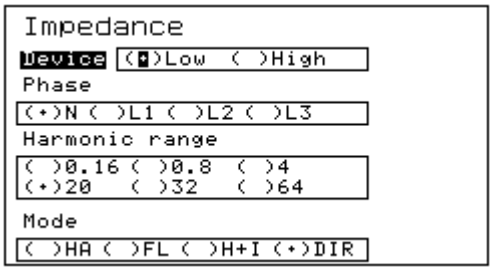
6.3.1. Operation Mode

Go to **Par**, with the cursor keys, select **Off, L12** for **Parallel Connection Amplifier 1-2** or **L123** for **Parallel Connection Amplifier 1-2-3** and press *Enter*.

When selecting parallel mode L12 or L123 the system is controlled via phase L1. The EUT has to be connected to phase L1.

6.4. Impedance (optional)

Go to **Impedance** by means of the cursor keys and press *Enter*.



6.4.1. Range

Go to **Device** by means of the cursor keys, select **Low** or **High** and press *Enter*. At **Low** the 16A-Impedance is selected; at **High** the 32A-Impedance and/or the 63A-Impedance.

6.4.2. Phase

Go to **Phase** by means of the cursor keys, select the phase and press *Enter*.

6.4.3. Harmonic Range

Go to **Harmonic Range** by means of the cursor key, select the range and press *Enter*.

6.4.4. Operation Mode

Go to **Mode** by means of the cursor keys, select the mode and press *Enter*.

HA = Harmonics

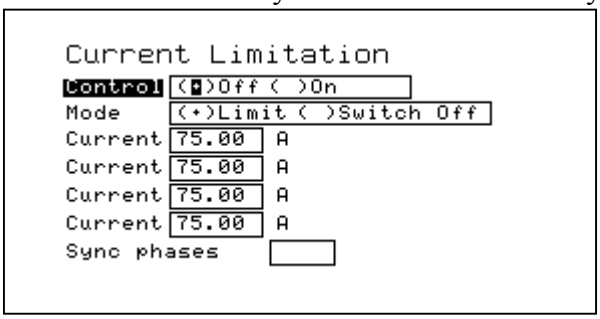
FL = Flicker

H+I = Harmonics and Impedance

DIR = Direct

6.5. Current Limitation (optional)

Go to **Current Limitation** by means of the cursor keys and press *Enter*.



6.5.1. Switching on

For switching off and/or on the current limitation go to **Control** by means of the cursor keys, select **Off** or **On** and press *Enter*.

6.5.2. Operation Mode

Go to **Mode** by means of the cursor keys, select **Limit** (current limitation) or **Switch off** (switching off) and press *Enter*.

6.5.3. Current Value

To adjust the limitation value and/or switching-off value of the current limitation go to **Current** by means of the cursor keys, feed the current value and press *Enter*.

6.5.4. Status

The status is indicated by the 2 LED's of the Func 4 button.

The LED's mean:

LED off = no limit/switch off

LED on = limit

LED off+on = switch off

6.5.5. Synchronized Amplitude Phases

Go to **Sync Phases** with the cursor keys, set the phases and press *Enter*.

The value Sync Phases indicates which amplitude phases are synchronized.
Adjust e.g. 123 to synchronize amplitude 1+2+3.

Description:

Operating mode Limit

When exceeding the adjusted current value, the output voltage is reduced to 0V and then increased until the pre-set current flows. The status LED (LED on Func 4-push-button) indicates the limiting.

Operating mode Switch Off

When exceeding the adjusted current value, the output is switched off. The status LED's (LED off+on Func 4-pushbutton) indicate the switching-off.

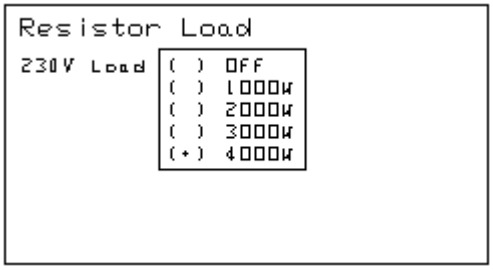
***Reference*:**

The current control is working with r.m.s.-values.

The reaction time is approx. 40ms.

6.6. Resistor Load (optional)

Go to **R-Load** with the cursor keys and press *Enter*.

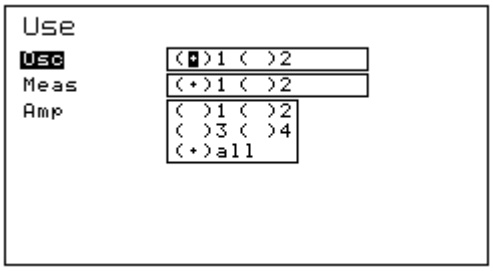


Select the requested load. The values are accepted by pressing the *Enter* key.

The specification of the power refers to 230V sink mode. When using other voltages the power has to be converted accordingly. Even though the load can be used in normal operation it is actually designed for the sink mode to increase the consumable power.

6.7. Amplifier Selection (optional)

Go to **Use** with the cursor keys and press *Enter*. The following is displayed:



6.7.1. Oscillator Card Selection

Go to **Osc** with the cursor keys, select **1** or **2** and press *Enter* (if available).

All following changes in the oscillator menu refer to the selected oscillator card.

6.7.2. Measurement Card Selection

Go to **Meas** with the cursor keys, select **1** or **2** and press *Enter* (if available).

All following changes in the measurement menu refer to the selected measurement card.

6.7.3. Amplifier Selection

Go to **Amp** with the cursor keys, select **1, 2, 3, 4** or **all** and press *Enter* (if available).

All following changes in the amplifier control dialog refer to the selected amplifier.

6.8. Safe Communication with Amplifier (optional)

This function can not be switched via menu. It is enabled by the manufacturer when the used amplifier supports the protocol.

Background: advanced safety, the amplifier/amplifiers are switched off safely when the communication between SyCore and amplifier fails.

6.8.1. Reaction of the SyCore to incorrect Response from the Amplifier

When the adjustment of one or several amplifier fails three times in a row all amplifiers are switched off by the SyCore (Power off). The display indicates the message: „Error RS485 – Switched Power Off“. The message disappears when any key is pressed.

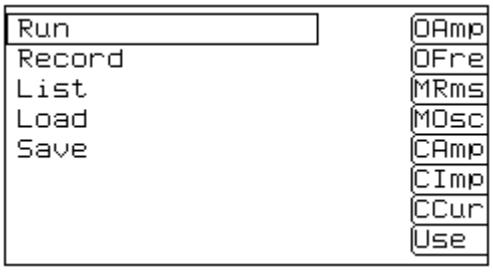
6.8.2. Reaction of the Amplifier to incorrect Checksum of the Adjustment- or Measurement Commands

When an amplifier receives an incorrect command (false checksum) the display indicates an error message. Additionally, both LEDs (beside the output push-button) are illuminated as long as the fault applies at the amplifier.

7. Macros

By means of the macro functions key strokes can be stored (Record), executed (Run), listed (List), loaded (Load), saved (Save) und deleted (Delete).

Go to **macros** with the *cursor*-keys and press *Enter*.



7.1. Execute Macros

Go to **run** with the *cursor* keys and press *Enter*.

Now the recorded or stored key strokes are executed.

7.2. Store Macros

Go to **record** with the *cursor* keys and press *Enter*.

In the right-down corner **rec** is indicated.

You are in the **macro record mode**.

Now the key strokes (except the soft keys) are stored.

To end the macro record-mode, please press the *Func4*-key.

Rec will be deleted in the right-down corner.

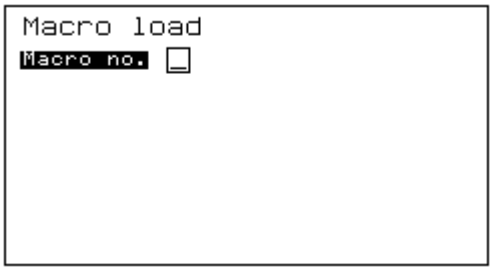
7.3. List Macros

Go to **list** with the *cursor* keys and press *Enter*.

Now the recorded or stored key strokes are listed.

7.4. Load Macros

Go to **Load** with the *cursor* keys and press *Enter*.



Feed the number of the macro (0 ... 9), where the key stroke is are stored. Now the loaded macro can be executed with **Run**.

7.5. Save Macros

Go to **Save** with the *cursor* keys and press *Enter*.

Feed the number of the macro (0 ... 9), where the key stroke is to be stored. The macro No 0 (Start-Macro) is loaded and executed when starting the device.

Now the key strokes are saved under the fed number of the macro (0 ... 9).

7.6. Overwrite Macros

Reference: Macros can only be overwritten and not deleted.

Macros can be overwritten as described in section 7.5 „Save Macros“. To delete a “Start-Macro” (No 0) act as follows:

1. Go to Macros-> Record.
2. Press the key Func4 to finish the macro recording.
3. Go to Macros->Save. Feed the number 0 (Start-Macro).

Example:

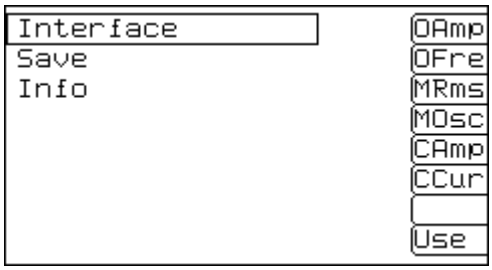
At switching-on the device the following fundamental state of the oscillator has to be executed: the angles of the phases 1 ... 3 of the oscillator have to be at 0°.

Please act as follows:

4. Go to Macros->Record. Now all key strokes are recorded.
5. Go to Oscillator->Amplitude/Angle. Feed an angle (phase 1 ... 3) of 0°.
6. Press the *Func4*-key to end the macro record.
7. Go to Macros->Save. Feed the number 0 (Start-Macro). Now the angles of the phases 1 ... 3 are set to 0° when switching on the device.

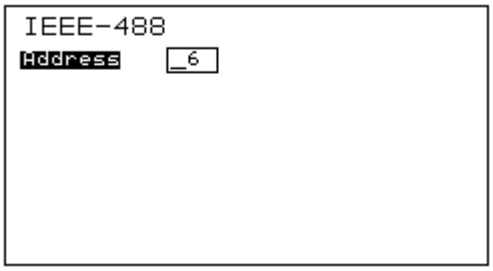
8. Set-up

Open the menu **Setup**. The display shows:



8.1. Adjustment of the Interface address

Go to **Interface** with the cursor keys and press *Enter*.



Go to **Address** with the cursor keys, feed the requested IEEE-Interface address and press *Enter*.

8.2. Info

Go to **Info** with the cursor keys and press *Enter*.

This window displays the following information:

- Copyright and name of the company
- Version number of the firmware
- Number of the connected amplifiers and control mode
- Installed oscillator cards
- Installed and/or connected measurement cards
- Configuration Bytes

9. IEEE488 Interface

The device can be controlled via IEEE488 interface. A large number of commands and queries are available.

This section describes the installation of the IEEE module. IEEE488 is a parallel 8 bit communication standard that enables the communication of the device with an external controller e.g. a computer or a terminal.

To each device a single IEEE address is assigned. The application of one address for two devices is not allowed.

The IEEE address is factory-set to 6.

If required, the IEEE address can be changed in the configuration menu (section 8.1).

Command sequences have to be closed with the final character LF (LINE FEED, HEX: 0A)+EOI-line.

9.1. Command Syntax

The basic structure of a command is made up of the elements command, space and argument.

Example: `AMP:Output 1`

AMP:Output is the command, 1 is the argument and between command and argument there is always a space.

The capital letters of the command must be input, the lower case letters are optional.

If several commands have to be transferred in one transfer sequence the commands have to be separated with a semicolon.

Example: `AMP:Mode 1;AMP:Output 1`

The basic structure of a query is made up of a command and a question mark (no space between command and question mark).

Example: `MEAS:Voltage?`

The return value is available for transmission in an output buffer.

In section 9.3 all control commands and queries are listed.

The following notation is used for the description of the command syntax:

Symbol	Meaning
< >	Defined element
{ }	Group, one element is required
[ ]	Optional, can be omitted
|	Exclusive Or
... .	Previous element(s) may be repeated

Example:

```
AMP:Output {0 | 1}
```

9.2. Command Synchronization

Complex test sequences or device control sequences require the synchronization of the executed program with the used IEEE-device. This is particularly important for time-consuming functions.

Example: The SyCore executes an amplitude pulse function for 12 seconds.

During this period the device does not accept device control commands (exception: BREAK-command). If further commands are sent during this period they are buffered in an input buffer (256 characters). If more than 256 characters are sent the buffer overflows and the device does not accept any further character. The LED **Func3** at the frontpanel is set to **On**. Subsequently, the following might happen:

- If the system controller releases no time-out the process is continued after finishing the function – no character is lost.
- If time-out occurs an incomplete command might remain in the input buffer. For a normal continuation of the command processing the interface command DCL or SDC should be sent (don´t mistake with the device command DCL). This command sets the input buffer to its initial state. If no DCL is sent the device takes the incomplete command together with the following command (due to the missing end character) and interprets it wrongly. The next but one command is interpreted correctly again.

In order to avoid these errors the application program and the command processing should be synchronized. Following is recommended:

- Wait the stated execution time after sending a command before sending the next one, particularly for the time consuming functions “amplitude pulse”, frequency pulse” (and their combinations) and “page control list”.
- After a group of commands the application could be synchronized by a simple query (e.g.: send *IDN? and wait for the return).
- The *OPC-function (or similar) is not available for the present firmware version of the SyCore.

9.3. List of Commands

The SyCore interface is structured in several sub-systems working more or less independent from each other. Following the sub-systems are described more closely.

Oscillator

Description	Command	Section
Active Oscillator card	OSC:Use	9.4.8
Adder/Multiplier	OSC:ADDMult	9.4.7
Amplitude	OSC:AMPlitude	9.4.1
Amplitude acceptance	OSC:AMPlitude:ACCept	9.4.2
Amplitude- and frequency pulse start	OSC:AFPuls:GO	9.4.19
Amplitude pulse delay time	OSC:APuls:DElayt	9.4.17
Amplitude pulse durationt	OSC:APuls:DURAT	9.4.14
Amplitude pulse end-amplitude	OSC:APuls:END	9.4.12
Amplitude pulse fall time	OSC:APuls:FALLT	9.4.15
Amplitude pulse pulse amplitude	OSC:APuls:PULS	9.4.11
Amplitude pulse repeats	OSC:APuls:REpeats	9.4.16
Amplitude pulse rise time	OSC:APuls:RISET	9.4.13
Amplitude pulse start	OSC:APuls:GO	9.4.18
Amplitudenpuls start amplitude	OSC:APuls:START	9.4.10
Frequency	OSC:FREQuency	9.4.4
Frequency pulse delay time	OSC:FPuls:DElayt	9.4.27
Frequency pulse duration	OSC:FPuls:DURAT	9.4.24
Frequency pulse end frequency	OSC:FPuls:END	9.4.22
Frequency pulse fall time	OSC:FPuls:FALLT	9.4.25
Frequency pulse pulse frequency	OSC:FPuls:PULS	9.4.21
Frequency pulse repeats	OSC:FPuls:REpeats	9.4.26
Frequency pulse rise time	OSC:FPuls:RISET	9.4.23
Frequency pulse start	OSC:FPuls:GO	9.4.28
Frequency pulse start frequency	OSC:FPuls:START	9.4.20
Phase angle	OSC:ANGle	9.4.3
Phases	Conf:Osc:PHases	9.4.9
Synchronisation	OSC:Sync	9.4.6
Trigger angle	OSC:TRigger	9.4.5

Page Control List

Description	Command	Section
Enable pulse operation	OSC:Page:PULS	9.5.8
Increase of the maximum frequency range	OSC:Page:PEriods	9.5.17
List cell cycles	OSC:Page:TOtalcycles	9.5.10
List cell paramter	OSC:Page:PArameter	9.5.16
List cell run after “BREAK”-command	OSC:Page:STopnumer	9.5.11
PCL clear	OSC:Page:CLear	9.5.15
PCL interrupt	OSC:BREAK	9.5.14
PCL start	OSC:Page:GO	9.5.12
PCL start by trigger	OSC:Page:GO	9.5.13
Waveform frequency	OSC:Page:FRequency	9.5.4
Waveform memory amplitude	OSC:Page:AMplitude	9.5.7
Waveform memory cycles	OSC:Page:CYcles	9.5.1
Waveform memory number	OSC:Page:NUmber	9.5.5
Waveform memory phase angle	OSC:Page:ANgle	9.5.6
Waveform memory size	OSC:Page:SIize	9.5.2
Waveform memory trigger angle	OSC:Page:TRigger	9.5.3
Waveform (adjust/query)	OSC:Page:FUnction	9.5.9
Memory depth (adjust/query)	OSC:PAge:MEMory	9.5.18

Measurement

Description	Command	Section
Active Measurement card	Meas:Use	9.6.14
Active power (query)	MEAS:POWer?	9.6.3
Apparent power (query)	MEAS:S?	9.6.4
Current crest factor (query)	MEAS:CFI?	9.6.10
Current peak value (query)	MEAS:IP?	9.6.8
Current value (query)	MEAS:CURRent?	9.6.2
Frequency of the voltage (query)	MEAS:FREQuency?	9.6.11
Measurement mode switching	Conf:Meas:Mode	9.6.12
Measuring phase switching	Conf:Meas:PH	9.6.13
Power factor (query)	MEAS:PF?	9.6.6
Reactive power (query)	MEAS:Q?	9.6.5
Voltage crest factor (query)	MEAS:CFU?	9.6.9
Voltage peak value (query)	MEAS:UP?	9.6.7
Voltage value (query)	MEAS:VOLTage?	9.6.1

Control

Description	Command	Section
Amplifier	AMP:ON	9.7.4
Amplifier	AMP:Power	9.7.5
Amplifier operation mode	AMP:Mode	9.7.3
Amplifier output	AMP:Output	9.7.1
Amplifier range	AMP:Range	9.7.2
Amplifier selection	AMP:USE	9.7.10
2/4-quadranten operation	AMP:Quadrants	9.7.11
Amplifier status	Status:Amp	9.7.9
Amplifier upper range values	Conf:Amp:Range	9.7.6
Current limitation	CURR:Limitation:Control	9.7.17
Current limitation current value	CURR:Limitation:Level	9.7.19
Current limitation operation mode	CURR:Limitation:Mode	9.7.18
Current limitation status	Status:Curr	9.7.20
Impedance harmonic range	IMP:Harm:Range	9.7.15
Impedance operation mode	IMP:Mode	9.7.14
Impedance phase	IMP:Phase	9.7.12
Impedance range	IMP:Range	9.7.13
Inrush Current Source	INRush:Current:Source	9.7.16
Internal resistance adjustment	RNW:RI	9.7.21
Internal resistance operation mode	RNW:Mode	9.7.22
Parallel switching	AMP:PAR	9.7.8
Pulse operation	AMP:PUlse	9.7.7
Resistor load	RLoad:Load	9.7.23

Interface

Description	Command	Section
Binary data mode	DATA:SET	9.9.5.1
Binary data size	DATA:SIZE	9.9.5.2
Binary data transfer	DATA:WRITE	9.9.5.4
Default setting	DCL	9.9.2
Device address	Conf:IEee:ADR	9.9.4
Identification	*IDN?	9.9.3
Manual control	GTL	9.9.1
Source pointer / destination pointer	DATA:POINTER	9.9.5.3

9.4. Oscillator

The Oscillator-sub-system is structured as follows:

Conf
:Osc
:PHases
OSC
:AMPlitude
:ANGle
:FREQuency
:TRigger
:Sync
:ADDMult
:Use
:APuls
:START
:PULS
:END
:RISET
:DURAT
:FALLT
:DELAYT
:REPEATS
:GO
:FPuls
:START
:PULS
:END
:RISET
:DURAT
:FALLT
:DELAYT
:REPEATS
:GO
:AFPuls
:GO
:Page
:FUnction
:MEMory
:CYcles
:SIze
:TRigger
:FREQuency
:NUmber
:ANngle
:AMplitude
:TOtalcycles
:STopnumber
:PArameter
:CLear
:GO
BREAK

9.4.1. OSC:AMPlitude

This command is required for adjustment or query of the amplitude.
The amplitude determines the value to be multiplied with the value of the waveform memory.
The amplitude value is accepted at the adjusted trigger angle (see 9.4.5).
Execution time: approx. 20ms+1/frequency e.g. 20ms+1/50Hz=40ms
Default value = 0

Group
Oscillator

Syntax

OSC:AMPlitude <INT1>,<FLOAT1><LABEL1>

OSC:AMPlitude <INT1>?

Arguments
<INT1> is the phase number.

Phase: 1 ... 4.

<FLOAT1> is the amplitude value.

Range: +- adjusted range end value (setup:amplifier).

Resolution: range end value/65536, e.g. 270V/65536=0.00412V.

<LABEL1> is the dimension of the amplitude value.

Range: V/A/%.

Return
<FLOAT1>

Examples

```
osc:amp 1,100%
```

With this command the amplitude of the first phase is set to 100% of the adjusted amplifier range.

```
osc:amp 2,270V
```

With this command the amplitude of the second phase is adjusted to 270V.

(only at voltage amplifiers)

```
osc:amp 3,20A
```

With this command the amplitude of the third phase is adjusted to 20A.

(only at current amplifiers)

```
osc:amp 1?
```

Return:

```
123.4
```

This query returns an amplitude of 123.4 in the adjusted dimension.

9.4.2. OSC:AMPlitude:ACCept

With this command the acceptance mode for amplitude changes can be switched on/off.

The acceptance mode determines whether an amplitude change is accepted immediately.
Execution time: approx. 20ms
Default= 1 (changes are accepted immediately)

Group
Oscillator

Syntax

OSC:AMPlitude:ACCept <INT1>

OSC:AMPlitude:ACCept?

Arguments

<INT1> is the value for the acceptance mode

1 Acceptance mode on, amplitude changes are accepted immediately.

0 Acceptance mode off, amplitude changes are only accepted when the acceptance mode is switched on again. Thus it is possible to enable simultaneous changes at different phases with varying amplitude.

Range: 0-1

Return
<FLOAT1>

Examples

```
osc:amp:acc 1
```

With this command the acceptance mode is switched on. Amplitude changes are accepted immediately.

```
osc:amp:acc?
```

Return:

```
1
```

The acceptance mode is switched on.

9.4.3. OSC:ANGle

This command is required for the adjustment or query of the phase angle.
The phase angle determines the offset of the waveform memory readout.
The phase angle value is accepted at the adjusted trigger angle. (see 9.1.4).
Execution time: approx. 20ms+1/frequency e.g. 20ms+1/50Hz=40ms
Default value = 0°,120°,240,0°

Group
Oscillator

Syntax

OSC:ANGle <INT1>,<FLOAT1>

OSC:ANGle <INT1>?

Arguments
<INT1> is the phase number.

Range: 1 ... 4.

<FLOAT1> is the phase angle value.

Range: +- 360 in degree.

Resolution: 360/memory depth, e.g. 360/1k=0.35°.

Return
<FLOAT1>

Examples

```
osc:ang 1,0
```

With this command the phase angle of the first phase is adjusted to 0°.

```
osc:ang 2,120
```

With this command the phase angle of the second phase is adjusted to 120°.

```
osc:ang 3,240
```

With this command the phase angle of the third phase is adjusted to 240°.

```
osc:ang 2?
```

Return:

```
120
```

This query returns a phase angle of 120°.

9.4.4. OSC:FREQuency

This command is required for adjustment or query of the frequency.
The frequency determines the clock pulse of the waveform memory.
Execution time: approx. 20ms
Default value = 50 Hz

Group
Oscillator

Syntax

OSC:FREQuency <FLOAT1>

OSC:FREQuency?

Arguments
<FLOAT1> is the frequency value.

Range: fres-fmax (see table below).

Resolution: fres (see table below).

Phase number	Memory depth [B]	Max-Frequency [Hz]	Frequency resolution = Min.-Frequency [Hz]
1	256	39062.50	0.298023
1	1024	9765.62	0.074506
1	4096	2441.40	0.018626
1	16384	610.35	0.004657
2	256	19531.25	0.149012
2	1024	4882.81	0.037253
2	4096	1220.70	0.009313
2	16384	305.18	0.002328
4	256	9765.62	0.074506
4	1024	2441.40	0.018626
4	4096	610.35	0.004657
4	16384	152.59	0.001164
1	256 (2 Periods)	78131.00	0.596046
1	256 (4 Periods)	156262.00	1.192092

Return
<FLOAT1>

Examples

```
osc:freq 50
```

With this command the frequency is adjusted to 50Hz.

```
osc:freq?
```

Return:

50

50Hz are adjusted.

9.4.5. OSC:TRigger

This command is required for adjustment or query of the trigger angle.
The trigger angle determines the moment of acceptance of adjustments like amplitude or phase angle.
Execution time: approx. 20ms
Default value = 0°

Group
Oscillator

Syntax

OSC:TRigger <FLOAT1>

OSC:TRigger?

Arguments
<FLOAT1> is the phase angle value.

Range: +- 360 in degree.

Resolution: 360/memory depth, e.g. 360/1k=0.35°.

Return
<FLOAT1>

Example

```
osc:tr 90
```

With this command the trigger angle is adjusted to 90°.

```
osc:tr?
```

Return:

90

This query returns a trigger angle of 90°.

9.4.6. OSC:Sync

This command is required for adjustment and query of the synchronisation between the oscillator cards.
Execution time: approx. 20ms
Default value = OUT

If there are several oscillator cards in one device, they can be synchronized.

In: the oscillator is synchronised with the synchronizing pulse of the other internal oscillator.

Out: the oscillator sets the synchronizing pulse for the other internal oscillator.

Line: the oscillator is synchronised with line signal (only at option “mains synchronous”). If several oscillators are available all oscillators are set to **Line** in this operation mode.

Reference: Never set all oscillators to **In** because this may cause undefined operation modes. When switching off the operation mode **Line**, firstly **Out** has to be set. Afterwards one of the oscillators can be set to **In** again.

Group
Oscillator

Syntax

OSC:Sync <STRING1>

OSC:Sync?

Arguments
<STRING1> is the synchron-mode.

Range:

"IN" adjusts to „Synchron in“.

"OUT" adjusts to „Synchron out“.

"LINE" adjusts to „Synchron line“ (optional).

Return
<STRING1>

Example

```
osc:use 1
osc:sync "OUT"
osc:use 2
osc:sync "IN"
```

With this command

- the first oscillator card is selected and the synchronisation set to „Out“

- the second oscillator card is selected and the synchronisation set to „In“.

9.4.7. OSC:ADDMult

With this command the adder and multiplier of the oscillator can be adjusted (if multiplier available).
Execution time: ca. 50ms
Default value = Adder on

Group
Oscillator

Syntax

OSC:ADDMult { 0 | 1}

OSC:ADDMult?

Arguments
0=Adder on
1=Multiplier on

Return
<INT1> (0 or 1)

Examples

```
osc:addmult 1,0
```

The adder is switched on in the 1st Phase.

9.4.8. OSC:Use

This command is required for the selection of the active oscillator card.
Execution time: approx. 100ms
Default value = 1

If in one device several oscillator cards are available you can select to which oscillator card the following adjustments and queries refer.

Group
Oscillator

Syntax

OSC:Use <INT1>

OSC:Use?

Arguments
<INT1> is the number of the oscillator card.

Range: 1 ... 2.

Return
<INT1>

Examples

```
osc:use 1
osc:amp 4,0%
```

With this command the first oscillator card is selected and the amplitude of the fourth phase is adjusted to 0%.

```
osc:use 2
osc:freq 50
```

With this command the second oscillator card is selected and the frequency is adjusted to 50Hz.

9.4.9. Conf:Osc:PHases

This command is required for adjustment and query of the number of phases.
The number of phases determines whether the waveform memory is read out for one, two or four phases.
Execution time: approx. 20ms
Default value = 4 (1 at some special devices)

This command can be used to increase the maximum frequency of four-phase oscillators when only one phase is required. (See table 9.1.3.)

Syntax

Conf:Osc:PHases <INT1>

Conf:Osc:PHases?

Arguments
<INT1> is the number of phases.

Range: 1, 2, 4.

Return
<INT1 >

Examples

```
conf:osc:phases 4
```

With this command the number of phases is adjusted to 4.

```
conf:osc:phases?
```

Return:

```
4
```

This query returns a phase number of 4.

9.4.10. OSC:APuls:START

This command is required for adjustment and query of the start amplitude of a amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 0

Group
Oscillator

Syntax

OSC:APuls:START <FLOAT1><LABEL1>

OSC:APuls:START?

Arguments
<FLOAT1> is the amplitude value.

Range: +- adjusted range end value (setup:amplifier).

Resolution: range end value/65536, e.g. 270V/65536=0.00412V.

<LABEL1> is the dimension of the amplitude value.

Range: V/A/%.

Return
<FLOAT1>

Examples

```
osc:apuls:start 230V
```

With this command the start amplitude is adjusted to 230V.

```
osc:apuls:start?
```

Return:

```
230
```

This query returns a start amplitude of 230V.

9.4.11. OSC:APuls:PULS

This command is required for adjustment and query of the pulse amplitude of an amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 0

Group
Oscillator

Syntax

OSC:APuls:PULS <FLOAT1><LABEL1>

OSC:APuls:PULS?

Arguments
Amplitude value and dimension (see above).

Return
<FLOAT1>

Examples

```
osc:apuls:puls 0V
```

With this command the pulse amplitude is set to 0V.

```
osc:apuls:puls?
```

Return:

```
0
```

This query returns a pulse amplitude of 0V.

9.4.12. OSC:APuls:END

This command is required for adjustment and query of the end-amplitude of an amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 0

Group
Oscillator

Syntax

OSC:APuls:END <FLOAT1><LABEL1>

OSC:APuls:END?

Arguments
Amplitude value and dimension (see above).

Return
<FLOAT1>

Examples

```
osc:apuls:end 230V
```

With this command the end-amplitude is adjusted to 230V.

```
osc:apuls:end?
```

Return:

```
230
```

This query returns an end-amplitude of 230V.

9.4.13. OSC:APuls:RISET

This command is required for adjustment and query of the rise time of an amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:APuls:RISET <FLOAT1>

OSC:APuls:RISET?

Arguments
<FLOAT1> is the time value in seconds

Range: 0 ... 3600.

Return
<FLOAT1>

Examples

```
osc:apuls:riset 0
```

With this command the rise time is adjusted to 0s.

```
osc:apuls:riset?
```

Return:

```
0
```

This query returns a rise time of 0s.

9.4.14. OSC:APuls:DURAT

This command is required for adjustment and query of the pulse duration of an amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:APuls:DURAT <FLOAT1>

OSC:APuls:DURAT?

Arguments
<FLOAT1> is the time value in seconds
Range 0 ... 3600

Return
<FLOAT1>

Examples

```
osc:apuls:durat 0.02
```

With this command the pulse time is adjusted to 0.02s.

```
osc:apuls:durat?
```

Return:

```
0.02
```

This query returns a pulse time of 0.02s.

9.4.15. OSC:APuls:FALLT

This command is required for adjustment and query of the fall time of an amplitude pulse (see 4.4.1).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:APuls:FALLT <FLOAT1>

OSC:APuls:FALLT?

Arguments
<FLOAT1> is the time value in seconds
Range 0 ... 3600

Return
<FLOAT1>

Examples

```
osc:apuls:fallt 0
```

With this command the fall time is adjusted to 0s.

```
osc:apuls:fallt?
```

Return:

```
0
```

This query returns a fall time of 0s.

9.4.16. OSC:APuls:REpeats

This command is required for adjustment and query of the number of repeats of an amplitude pulse (see 4.7.1).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:APuls:REpeats <INT1>

OSC:APuls:REpeats?

Arguments
<INT1> is the number of repeats
Range 0 ... 1000 (0 = continuous operation)

Return
<INT1>

Examples

```
osc:apuls:repeats 2
```

With this command the number of repeats is adjusted to 2.

```
osc:apuls:repeats?
```

Return:

```
0
```

This query returns 2 repeats.

9.4.17. OSC:APuls:DElayt

This command is required for adjustment and query of the delay time between the amplitude pulses (see 4.7.1).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:APuls:DElayt <FLOAT1>

OSC:APuls:DElayt?

Arguments
<FLOAT1> is the time value in seconds
Range 0 ... 3600

Return
<FLOAT1>

Examples

```
osc:apuls:delayt 1
```

With this command the delay time is adjusted to 1 second.

```
osc:apuls:delayt?
```

Return:

```
1
```

This query returns a delay time of 1 second.

9.4.18. OSC:APuls:GO

This command is required for the starting of an amplitude pulse (see 4.7.1).
Execution time: ca. 20ms+Risetime+Durationtime+Falltime (see section 9.2)
Default value = none

During the pulse no commands (except BREAK) can be sent (see section 9.5.14).

Group
Oscillator

Syntax

OSC:APuls:GO <INT1>

Arguments
<INT1> is the phase number and/or a combination of the phases

Range: 1 … 4

Return
<INT1>

Example

```
osc:apuls:go 1234
```

With this command the amplitude pulse is started on the phases 1, 2, 3 and 4.

```
osc:apuls:go?
```

Return:

```
1234
```

This query returns the phase numbers 1234; that means the amplitude pulse is executed on each phase.

9.4.19. OSC:AFPuls:GO

This command is required for the starting of an amplitude and frequency pulse (see 4.7.1).
Execution time: ca. 20ms+Risetime+Durationtime+Falltime (see section 9.2)
Default value = none

During the pulse no commands (except BREAK) can be sent (see section 9.5.14).

Group
Oscillator

Syntax

OSC:AFPuls:GO <INT1>

Arguments
<INT1> is the phase number and/or a combination of the phases

Range: 1 … 4

Return
<INT1>

Example

```
osc:afpuls:go 1234
```

With this command the amplitude and frequency pulse is started on the phases 1, 2, 3 and 4.

```
osc:afpuls:go?
```

Return:

```
1234
```

This query returns the phase numbers 1234; that means the amplitude and frequency pulse is executed on each phase.

9.4.20. OSC:FPuls:START

This command is required for adjustment and query of the start frequency of a frequency pulse (see 4.4.2).
Execution time: approx. 20ms
Default value = 50 Hz

Group
Oscillator

Syntax

OSC:FPuls:START <FLOAT1>

OSC:FPuls:START?

Arguments
<FLOAT1> is the frequency value in Hertz.

Range: fres-fmax (see section 9.4.4)

Resolution: fres (see section 9.4.4)

Return
<FLOAT1>

Examples

```
osc:fpuls:start 50
```

With this command the start frequency is adjusted to 50Hz.

```
osc:fpuls:start?
```

Return:

```
50
```

This query returns a start frequency of 50Hz.

9.4.21. OSC:FPuls:PULS

This command is required for adjustment and query of the pulse-frequency of a frequency pulse (see 4.4.2).
Execution time: approx. 20ms
Default value = 50 Hz

Group
Oscillator

Syntax

OSC:FPuls:PULS <FLOAT1>

OSC:FPuls:PULS?

Arguments
<FLOAT1> is the frequency value in Hertz.

Range: fres-fmax (see section 9.4.4)

Resolution: fres (see section 9.4.4)

Return
<FLOAT1>

Examples

```
osc:fpuls:puls 150
```

With this command the pulse-frequency is adjusted to 150Hz.

```
osc:fpuls:puls?
```

Return:

```
150
```

This query returns a pulse frequency of 150Hz.

9.4.22. OSC:FPuls:END

This value is required for adjustment and query of the end-frequency of a frequency pulse (see 4.4.2).
Execution time: ca. 20ms
Default value = 50 Hz

Group
Oscillator

Syntax

OSC:FPuls:END <FLOAT1>

OSC:FPuls:END?

Arguments
<FLOAT1> is the frequency value in Hertz.

Range: fres-fmax (see section 9.4.4)

Resolution: fres (see section 9.4.4)

Return
<FLOAT1>

Examples

```
osc:fpuls:end 50
```

With this command the end-frequency is adjusted to 50Hz.

```
osc:fpuls:end?
```

Return:

```
50
```

This query returns an end-frequency of 50Hz.

9.4.23. OSC:FPuls:RISET

This command is required for adjustment and query of the rise time of a frequency pulse (see 4.4.2).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:FPuls:RISET <FLOAT1>

OSC:FPuls:RISET?

Arguments
<FLOAT1> is the time value in seconds

Range: 0 ... 3600.

Return
<FLOAT1>

Examples

```
osc:fpuls:riset 0
```

With this command the rise time is adjusted to 0s.

```
osc:fpuls:riset?
```

Return:

```
0
```

This query returns a rise time of 0s.

9.4.24. OSC:FPuls:DURAT

This command is required for adjustment and query of the duration of a frequency pulse (see 4.4.2).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:FPuls:DURAT <FLOAT1>

OSC:FPuls:DURAT?

Arguments
<FLOAT1> is the time value in seconds

Range: 0 ... 3600.

Return
<FLOAT1>

Examples

```
osc:fpuls:durat 0.02
```

With this command the duration is adjusted to 0.02s.

```
osc:fpuls:durat?
```

Return:

```
0.02
```

This query returns a duration of 0.02.

9.4.25. OSC:FPuls:FALLT

This command is required for adjustment and query of the fall time of a frequency pulse (see section 4.7.2).
Execution time: ca. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:FPuls:FALLT <FLOAT1>

OSC:FPuls:FALLT?

Arguments
<FLOAT1> is the time value in seconds

Range: 0 ... 3600.

Return
<FLOAT1>

Examples

```
osc:fpuls:fallt 0
```

With this command the fall time is adjusted to 0s.

```
osc:fpuls:fallt?
```

Return:

```
0
```

This query returns a fall time of 0s.

9.4.26. OSC:FPuls:REpeats

This command is required for adjustment and query of the number of repeats of a frequency pulse (see 4.7.2).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:FPuls:REpeats <INT1>

OSC:FPuls:REpeats?

Arguments
<INT1> is the number of repeats
Range 0 ... 1000 (0 = continuous mode)

Return
<INT1>

Examples

```
osc:fpuls:repeats 2
```

With this command the number of repeats is adjusted to 2.

```
osc:fpuls:repeats?
```

Return:

```
0
```

This query returns 2 repeats.

9.4.27. OSC:FPuls:DElayt

This command is required for adjustment and query of the delay time between the frequency pulses (see 4.7.2).
Execution time: approx. 20ms
Default value = 1s

Group
Oscillator

Syntax

OSC:FPuls:DElayt <FLOAT1>

OSC:FPuls:DElayt?

Arguments
<FLOAT1> is the time value in seconds
Range 0 ... 3600

Return
<FLOAT1>

Examples

```
osc:fpuls:delayt 1
```

With this command the delay time is adjusted to 1 second.

```
osc:fpuls:delayt?
```

Return:

```
1
```

This query returns a delay time of 1 second.

9.4.28. OSC:FPuls:GO

This command is required for the starting of a frequency pulse (see section 4.7.2).
Execution time: approx. 20ms+Risetime+Durationtime+Falltime (see section 9.2)
Default value = none

During the pulse no commands (except BREAK) can be sent (see section 9.5.14).

Group
Oszillator

Syntax

OSC:FPuls:GO

Arguments
Return
Example

```
osc:fpuls:go
```

With this command the frequency pulse is started.

9.5. Page Control List

The Page Control List (in the following text described as PCL) offers a simple possibility for the sequential link of waveform in the waveform memory.

The PCL is a list with 256 list cells maximum. In each list cell a waveform with its features like amplitude, phase angle etc. is defined. After definition the PCL can be started, as a result, one after the other of the list cells is worked off and the output signal is generated according to the specifications.

For programming of the PCL an extensive command set is available.

These commands are referring to all phases:

1. OSC:Page:CYcles number of periods to be output
2. OSC:Page:SIze memory depth for one period
3. OSC:Page:TRigger acceptance trigger angle
4. OSC:Page:FRequency frequency

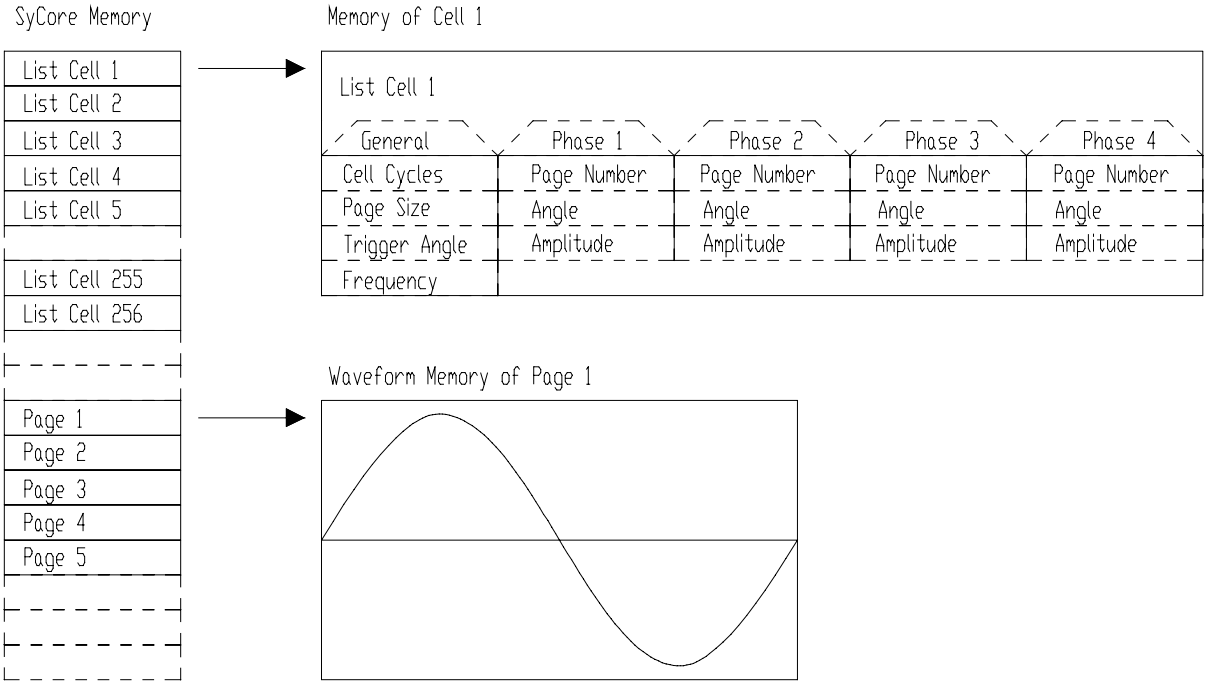
These commands are referring to each single phase:

1. OSC:Page:NUmber page number of the waveform memory
2. OSC:Page:ANngle phase angle
3. OSC:Page:AMplitude amplitude

Further PCL commands:

1. OSC:Page:TOtalcycles repetitions for the whole PCL
2. OSC:Page:STop-number defines continuation of PCL after execution
3. OSC:Page:GO start PCL
4. BREAK interrupt PCL run
5. OSC:Page:CLear clear PCL
6. OSC:Page:PArameter query PCL

Schematic memory division of the PCL in relation with the waveform memory:



NOTICE: Once activated, an adjustment keeps its validity until it is overwritten in a later list cell.

Example: If in list cell 1 a frequency of 50Hz is defined, this frequency remains valid for all following list cells until a new frequency is defined in a later list cell.

This is also valid at PCL start: The settings made by using normal commands (or manual settings) like *osc:amplitude* or *osc:frequency* remain valid until they are overwritten by the PCL.

For the programming of the PCL the following scheme should be used:

1. Clear PCL (command: OSC:Page:Clear)
2. Program the PCL with the requested function.
3. Deposit the requested waveform in the waveform memory
4. Start PCL (OSC:Page:GO)

9.5.1. OSC:Page:CYcles

This command defines how often the contents of a waveform memory (page) are output.

Syntax

OSC:Page:CYcles <INT1>,<INT2>

Arguments

<INT1> List cell number
Valid range: 1 ... 256

<INT2> Number of repeats (periods)
Valid range: 1 ... 32767
(the valid range of some older devices is 1 ... 1000)

Default value after „osc:page:clear“: 0
0 means no execution of the current list cell

Examples

```
osc:page:cycles 2,5
```

With this command a repeat value of 5 is stored in the list cell 2.

After starting the PCL and reaching the list cell 2 the current waveform memory is output five times.

9.5.2. OSC:Page:SIze

With this command the memory depth (pagesize) for a waveform output is defined.

Syntax

OSC:Page:Size <INT1>,{ 0 | 1 | 4 | 16 | 64 | 256 | 1024 }

Arguments

<INT1> List cell number
Valid range: 1-256

{ 0 | 1 | ... } Memory depth for a waveform
Valid arguments:

0	=	0.25Kbyte / 256 points	
1	=	1Kbyte / 1024 points	
4	=	4Kbyte / 4096 points	(only at 64kB or 1MB Oscillator)
16	=	16Kbyte / 16384 points	(only at 64kB or 1MB Oscillator)
64	=	64Kbyte / 65536 points	(only at 64kB or 1MB Oscillator)
256	=	256Kbyte / 264144 points	(only at 1MB Oscillator)
1024	=	1024Kbyte / 1048576 points	(only at 1MB Oscillator)

The whole waveform memory has a size of 1K (1024), 64K (65536) or 1M (1048576) points (dependent on its configuration)

The maximum number of waveform memories (pages) is calculated from the size of the whole waveform memory and the adjusted memory depth.

e.g. 1M (1048576)/1K (1024)=1K (1024) pages.

Examples

```
osc:page:size  1,1
```

With this command a waveform memory depth of 1024 points is adjusted for the list cell 1.

9.5.3. OSC:Page:TRigger

This command defines the trigger angle for the acceptance of the next list cell values.

Syntax

OSC:Page:TRigger <INT1>,<FLOAT1>

Arguments

<INT1> List cell number
Valid range: 1 ... 256

<FLOAT1> Trigger angle value for the acceptance of the next list cell values.
Valid range: 0 ... 360° (floating-point number)

The possible angle resolution depends on the waveform memory depth. By means of the following formula the angle resolution can be calculated:

Smallest possible resolution = 360 / waveform memory depth.

e.g. 360°/1024 = 0.351°

Example

```
osc:page:trigger 1,90
```

With this command a trigger angle of 90° is stored in the list cell 1.

9.5.4. OSC:Page:FRequency

With this command the frequency for a waveform output can be programmed.

Note: The frequency adjustment is valid for all phases of the current oscillator card.

Syntax

OSC:Page:FRequency <INT1>,<FLOAT1>

Arguments

<INT1> List cell number
Valid range: 1 ... 256

<FLOAT1> Defines the frequency

The minimum frequency, the maximum frequency and the frequency resolution depend on several factors, e.g. the waveform memory depth or the number of phases. See also section „memory depth“ for further details.

Examples

```
osc:page:frequency 1,50
```

With this command a frequency of 50Hz is stored in the list cell 1.

9.5.5. OSC:Page:NUmber

This command assigns a waveform memory page to the requested phase in a list cell.

Note: The same waveform memory (page) can be assigned to several list cells.

Syntax

OSC:Page:NUmber <INT1>,<INT2>,<INT3>

Arguments

<INT1>	List cell number Valid range: 1 ... 256
<INT2>	Phase number Valid range: 1 ... 4
<INT3>	Page number: 1 ... XXX The maximum page number depends on several factors. (see: OSC:Page:SIze)

Example:

```
osc:page:number 1,1,1
osc:page:number 1,2,1
osc:page:number 1,3,1
osc:page:angle 1,1,0
osc:page:angle 1,2,120
osc:page:angle 1,3,240
```

The same waveform memory is assigned to the three phases of list cell 1. The different phase angles result in a three-phase system.

9.5.6. OSC:Page:ANgle

This value indicates the phase angle of the waveform memory (page) is output.

Syntax

OSC:Page:ANgle <INT1>,<INT2>,<FLOAT1>

Arguments

<INT1>	List cell number Valid range: 1 ... 256
<INT2>	Phase number Valid range: 1 ... 4
<FLOAT1>	Start angle the output of the waveform memory is started with. Corresponds to a phase shift against pseudo-phase 0. Valid range: 0 ... 360° (floating-point number)

The maximally possible angle resolution depends on the waveform memory depth. With the following formula the angle resolution can be calculated:

Smallest possible resolution = 360 / waveform memory depth.

e.g. 360/1024 = 0.351 degree.

Examples:

```
osc:page:angle 1,1,90
```

With this command a phase angle of 90° is stored in the list cell 1.

9.5.7. OSC:Page:AMplitude

This command defines the amplitude for a waveform output.

Syntax

OSC:Page:AMplitude <INT1>,<INT2>,<FLOAT1>

Arguments

<INT1>	List cell number Valid range: 1 ... 256
<INT2>	Phase number Valid range: 1 ... 4
<FLOAT1>	Proportional amplitude value with which the content of the waveform memory is output. Valid range: 0 ... 100 (floating-point number)

A proportional amplitude value of 100 corresponds to the current amplifier range end value.

Proportional amplitude = amplitude / range end value * 100

For adjusting an output voltage of 230V AC at a 270V AC-standard amplifier a amplitude value of 81.18% has to be programmed.

Examples

```
osc:page:amplitude 1,3,50
```

With this command an amplitude of 50% for phase 3 is stored in list cell 1.

9.5.8. OSC:Page:PULS

With this command the pulse operation can be enabled (see section 9.5.1) within the PageControlList (if available).

Before using the pulse operation a 30ms pre-lead time is required during PCL-cycle (for shifting-up of the power supply by hardware).

This command shall also be sent in a preceding page.

Execution time: ca.30ms
Default: 0

Syntax

OSC:PAGE:PULSE <INT1>,<INT2>

Argumente

<INT1>	List cell number Valid range: 1 … 256
<INT2>	Switch pulse operation Valid range: 0 = OFF , 1 = positive, 2 = negative

Examples

```
osc:page:pulse 3,1
```

Switches the positive pulse operation in the 3rd page. After 30ms it can be used.

```
osc:page:pulse 6,0
```

Switches off the pulse operation in the 6th page.

9.5.9. OSC:Page:FUnction

This command is required for generation and query of a waveform.
Execution time: approx. 0.25s per 1k depth
Default value = SINE

Note: amplitude 1 ... 4 is adjusted to 0.

Syntax

OSC:Page:FUnction <INT1>,<STRING1>

OSC:Page:FUnction?

Arguments
<INT1> is the phase number.

<STRING1> is the type of function.

Possible values:

"SINE" generates a sine waveform.

"PULS" generates a pulse waveform.

"TRIA" generates a triangle waveform.

"RAMP" generates a ramp waveform (saw-tooth).

"RECT" generates a rectangle waveform.

"DC" generates a DC waveform.

Return
<STRING1>

Examples

```
osc:page:function 1,"SINE"
```

With this command a sine-waveform is generated.

```
osc:page:function 1?
```

Return:

```
"SINE"
```

This query returns a sine-waveform.

9.5.10. OSC:Page:TOtalcycles

This value indicates how often the output of the whole PCL is repeated.

Syntax

OSC:Page:TOtalcycles <INT1>

Arguments

<INT1> Number of repetitions
Valid range: 1 ... 1000
Default value after „osc:page:clear“: 0

Examples:

```
osc:page:totalcycles 2
```

With this command the value 2 is stored.

The complete PCL is running twice.

9.5.11. OSC:Page:STopnumber

This value indicates which list cell is running after a „BREAK“-command before PCL is stopped. 0 means output of the current list cell at the moment of the BREAK command.

Syntax

OSC:Page:Stop-number <INT1>

Arguments

<INT1> List cell number
Valid range: 0 ... 256

Above all, this command is useful for the program development e.g. for defined interrupting of many repetitions (cycles).

Examples

```
osc:page:stop-number 10
```

With this command list cell 10 is defined as stop list cell.

9.5.12. OSC:Page:GO

With this command the PCL run is started (see section 9.2).

Syntax

OSC:Page:GO

Arguments

None

NOTICE: During the PCL run no commands should be sent to the SyCore.

Exception: „BREAK“

Examples

```
osc:page:go
```

Start of PCL

9.5.13. OSC:Page:GOBY trigger (optional)

With this command the PCL is armed for the start with an external trigger. (only when trigger card is installed). Now the run can be started by a start-trigger (please see section 10.6).

Syntax

OSC:Page:GOBYtrigger

Arguments

None

Reference: During the run of the PLC no commands can be sent to the SyCore (except „BREAK“ and „OSC:Page:STopnumber“).

Examples

```
osc:page:gobytrigger
```

The PCL is armed for the start by trigger.

9.5.14. BREAK

With this command a running PCL run can be interrupted.

Syntax

BREAK

Arguments

None

At „BREAK“ the run of the current list cell is interrupted. If stop-number=0 is programmed an immediate interrupt happens. Otherwise the list cell defined by stop-number runs and the PCL is finished.

Examples

```
BREAK
```

With this command the running PCL is interrupted.

9.5.15. OSC:Page:CLear

This command is meant for clearing the complete PCL.

Syntax

OSC:Page:CLear

Arguments

None

Examples

```
osc:page:clear
```

With this command all adjustments in the list are cleared.

9.5.16. OSC:Page:PArameter

With this command the content of a list cell can be read out.

Syntax

OSC:Page:PArameter <INT1>?

Arguments

<INT1> List cell number
Valid range: 1 ... 256

Return

<String>

Format:

TO=[TotalCycles],ST=[Stop],CY=[Cycles],

SI=[Size],TR=[Trigger],FR=[Frequency],

NU=[1][Number P1],[2][Number P2],[3][Number P3],[4][Number P4],

AN=[1][Angle P1],[2][Angle P2],[3][Angle P3],[4][Angle P4],

AM=[1][Amplitude P1],[2][Amplitude P2],[3][Amplitude P3],[4][Amplitude P4]

Examples

```
osc:page:parameter 1?
```

Return:

```
TO=1,ST=0,CY=1,
SI=1,TR=90,FR=50,
NU=[1]1,[2]1,[3]1,[4]1,
AN=[1]0,[2]120,[3]240,[4]0,
NU=[1]230,[2]230,[3]230,[4]1
```

9.5.17. OSC:Page:PEriods

With this command the frequency can be multiplied with the factor x in order to increase the maximum frequency range.

Syntax

OSC:Page:PEriods <INT1>

Arguments

<INT1> Multiplication factor x
valied factors: 1, 2, 4, 8

Example

```
osc:page:periods 4
```

The maximum frequency is increased by the factor 4.

Current maximum frequency range: 2441Hz
Increased maximum frequency range: 9764Hz

9.5.18. OSC:Page:MEMory

This command is required for adjustment and query of the memory depth.
The memory depth determines the size of the waveform memory to be read out.
Execution time: approx. 20ms
Default value = 1k points

After the adjustment the waveform has to be re-generated.

Note: amplitude 1 ... 4 is adjusted to 0.

Group
Oszillator

Syntax

OSC:Page:MEMory <INT1>

OSC:Page:MEMory?

Arguments
<INT1> is the memory depth.

Possible values:

0 = 256 points .

1 = 1024 points .

4 = 4096 points (only at 64kB or 1MB Oscillator)

16 = 16384 points (only at 64kB or 1MB Oscillator)

64 = 65536 points (only at 64kB or 1MB Oscillator)

256 = 264144 points (only at 1MB Oscillator)

1024 = 1048576 points (only at 1MB Oscillator)

Return
<INT1>

Examples

```
osc:page:mem 1
```

With this command a memory depth of 1 (1024 points) is adjusted.

```
osc:page:mem?
```

Return:

```
1
```

This query returns a memory depth of 1 (1024 points).

9.5.19. Examples

Example 1:
Generate a 10% amplitude magnification for one period (20ms).

Proceeding 1

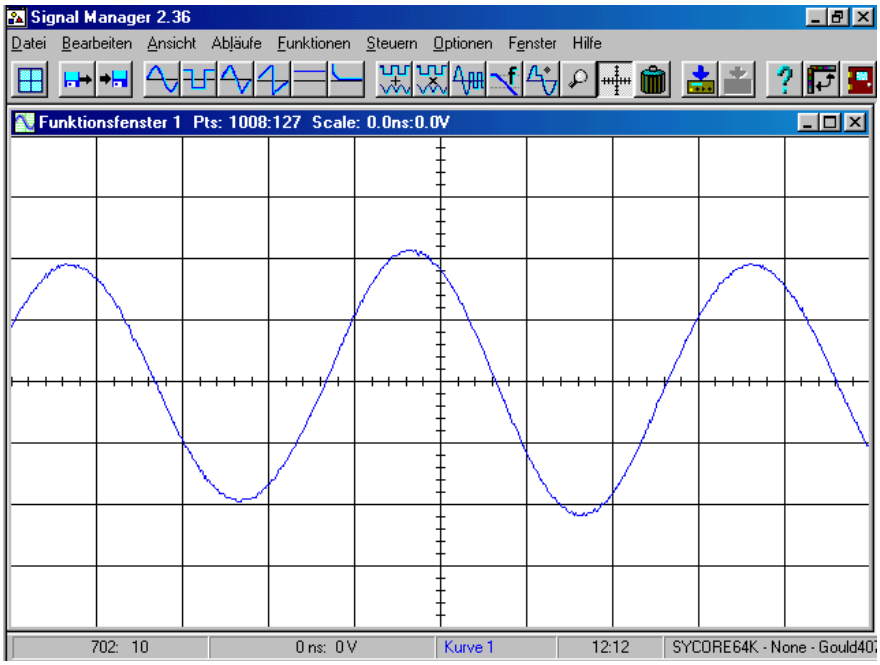
A page with a stored sine is required. When using a standard oscillator the page 1 is already initialised with sine (50Hz) after switching on. This is the standard page for the output of the waveform (see section 4.2). The first PCL list cell is used for the rise, the second one for the remaining state.

Example with SPS-Scriptmanager:

```
send 6,10,"osc:amplitude 1,85%"          //Amplitude of phase 1 at 85%
                                         //in 270V range=230V
send 6,10,"osc:page:clear"               //PCL clear
send 6,10,"osc:page:cycles 1,1"          //List cell 1: output 1x page
send 6,10,"osc:page:amplitude 1,1,93.7"  //List cell 1: amplitude of Phase 1 at 93.7%
                                         //in 270V range=253V
send 6,10,"osc:page:cycles 2,1"          //List cell 2: output 1x page *
send 6,10,"osc:page:amplitude 2,1,85"    //List cell 2: amplitude of phase 1 again
                                         //at 85% in 270V range=230V
send 6,10,"osc:page:totalcycles 1"       //output 1x PCL
send 6,10,"osc:page:go"                  //start PCL
```

* After this cycle the output remains on this page. However, the smallest possible value (1) should be adjusted to make the fixed run of the PCL as short as possible.

Measured signal at oscillator output:



Proceeding 2

For a better illustration of the functionality the same rise is generated in another way.
A page with a stored sine is required as well. Page 1 is used for standard page for the output of the waveform (see section 4.2) as well. The first PCL list cell is used for the adjustment of the operation voltage, the second for the rise.

Example with SPS-Scriptmanager:

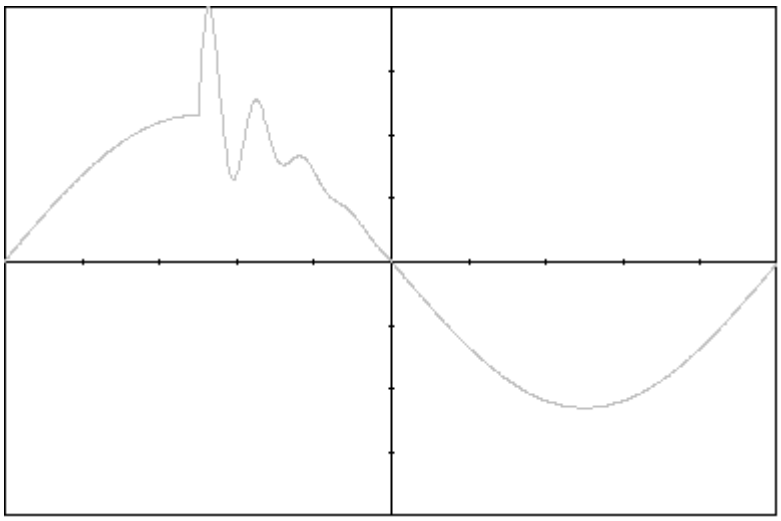
```
send 6,10,"osc:page:clear"                  //PCL clear
send 6,10,"osc:page:cycles 1,1"             //List cell 1: output page 1x
send 6,10,"osc:page:amplitude 1,1,85"       //List cell 1: amplitude of phase 1 at 85%
                                            //in 270V range=230V
send 6,10,"osc:page:cycles 2,1"             //List cell 2: output page 1x
send 6,10,"osc:page:amplitude 2,1,93.7"     //List cell 2: amplitude of phase 1 at 93.7%
                                            //in 270V range=253V
send 6,10,"osc:page:stopnumber 1"           //after run of the PCL List cell 1
                                            //is output
send 6,10,"osc:page:totalcycles 1"          //output 1x PCL
send 6,10,"osc:page:go"                     //start PCL
```

Because 230V should be output again after the cycle a stop number is defined here.

Example 2:

Generation of a ring-waveform (for 64k oscillator).
Duration: one period (20ms) .

First of all the following waveform has to be transferred into phase 2 (page 17).



Example in C:

```
Ieee.SendString(6, "DATA:POINTER 1,32768");          //Set data destination at phase 2
Wait(10);
Ieee.SendString(6, DATA:SIZE 2048");                 //Set data size for 1K curve
Wait(10);
Ieee.SendString(6,"DATA:SET");                       //Set transfer mode
Wait(10);
Ieee.Transmit("UNL UNT MTA LISTEN6");                //Address SyCore as Listener
Wait(10);
Ieee.TransmitArray(Value,(uint)ActTransferPoints*2); //Transfer data into IEEE-Buffer
Wait(10);
Ieee.SendString(6,"DATA:WRITE");                     //Copy data from IEEE-Buffer
Wait(1000);                                          //to oscillator-waveform memory
```

Proceeding

A page with a stored sine is required. When using a standard oscillator the page 1 is already initialised with sine (50Hz) after switching on. This is the standard page for the output of the waveform (see section 4.2). The transferred ring-waveform is now in page 17. The first PCL list cell is used for the ring-waveform, the second one for the remaining state.

Example with SPS-ScriptManager:

```
send 6,10,"osc:amplitude 1,50%"          //Amplitude of Phase 1 at 50%
                                         //in 270V range=135V
send 6,10,"osc:page:clear"               //PCL clear
send 6,10,"osc:page:cycles 1,1"          //List cell 1: output page 1x
send 6,10,"osc:page:number 1,1,17"       //List cell 1: waveform memory of phase 1
                                         //(Page 1) set to  waveform memory of phase 2
                                         //(Page 17) , (at 64kByte oscillators)
send 6,10,"osc:page:amplitude 1,1,100"   //List cell 1: amplitude of phase 1 at 100%
send 6,10,"osc:page:cycles 2,1"          //List cell 2: output page 1x *
send 6,10,"osc:page:number 2,1,1"        //List cell 1: waveform memory of Phase 1
                                         //(Page 17) re-set waveform memory to phase 1
                                         //(Page 1)
send 6,10,"osc:page:amplitude 2,1,50"    //List cell 2: amplitude of phase 1 at 50%
                                         //in 270V range=135V
send 6,10,"osc:page:totalcycles 1"       //output a PCL
send 6,10,"osc:page:go"                  //start PCL
```

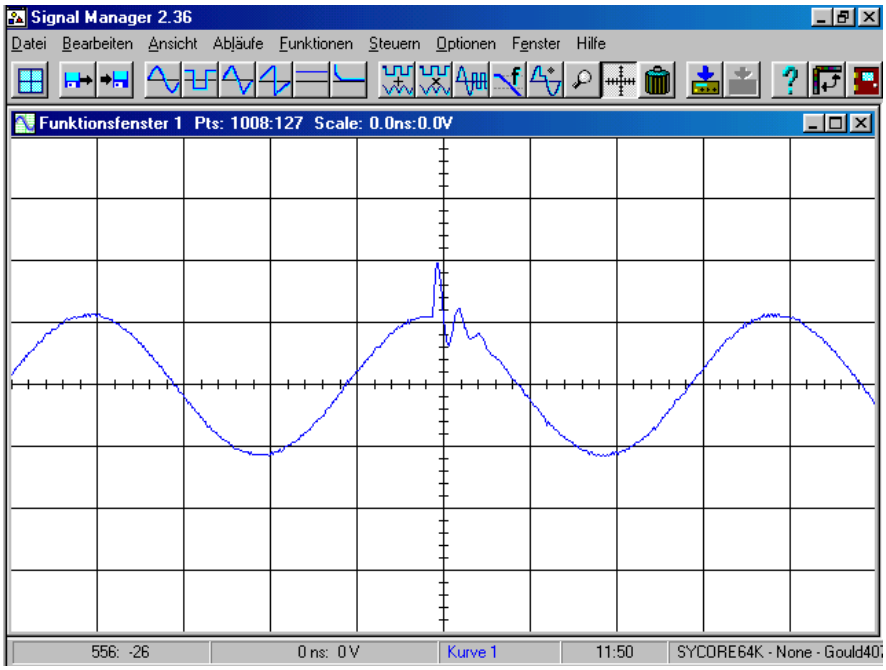
* After this cycle the output remains on this page. However, the smallest possible value (1) should be adjusted to make the fixed run of the PCL as short as possible.

Example in C:

```
Ieee.SendString(6,"osc:amplitude 1,50%");          //amplitude of phase 1 at 50%
Wait(10);                                          //in 270V range=135V
Ieee.SendString(6,"osc:page:clear");               //clear PCL
Wait(10);
Ieee.SendString(6,"osc:page:cycles 1,1");          //List cell 1: output page 1x
Wait(10);
Ieee.SendString(6,"osc:page:number 1,1,17");       //List cell 1: set waveform memory of
Wait(10);                                          //phase 1 (page 1) to waveform memory
                                                   //of phase 2 (page 17)
Ieee.SendString(6,"osc:page:amplitude 1,1,100");   //List cell 1: amplitude of phase 1
Wait(10);                                          //at 100% in 270V range=270V
Ieee.SendString(6,"osc:page:cycles 2,1");          //List cell 2: output page 1x *
Wait(10);
Ieee.SendString(6,"osc:page:number 2,1,1");        //List cell 1: re-set waveform memory of
Wait(10);                                          //phase 1 (Page 17) to waveform memory
                                                   //of phase 1 (Page 1)
Ieee.SendString(6,"osc:page:amplitude 2,1,50");    //List cell 2: amplitude of phase 1
Wait(10);                                          //at 50% in 270V range=135V
Ieee.SendString(6,"osc:page:totalcycles 1");       //output a PCL
Wait(10);
Ieee.SendString(6,"osc:page:go");                  //start PCL
Wait(10);
```

* After this cycle the output remains on this page. However, the smallest possible value (1) should be adjusted to make the fixed run of the PCL as short as possible.

Measured signal at oscillator output:



9.6. Measurement

The measurement sub-system is structured as follows:

MEAS
:VOLTage?
:CURRent?
:POWer?
:S?
:Q?
:PF?
:UP?
:IP?
:CFU?
:CFI?
:FREQuency?
Conf
:Meas
:Mode
:ac
:dc
:acdc
:PH
:Use

9.6.1. MEAS:VOLTage

With this command the voltage value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:VOLTage?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:voltage?
```

Return:

```
230.000
```

This query returns a voltage value of 230V.

9.6.2. MEAS:CURRent

With this command the current value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:CURRent?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:current?
```

Return:

```
50.000
```

This query returns a current value of 50A.

9.6.3. MEAS:POWer

With this command the power value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:POWer?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:power?
```

Return:

```
500.000
```

This query returns an active power value of 500W.

9.6.4. MEAS:S

With this command the apparent power value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:S?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:s?
```

Return:

```
500.000
```

This query returns an apparent power value of 500VA.

9.6.5. MEAS:Q

With this command the reactive power value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:Q?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:q?
```

Return:

```
50.000
```

This query returns a reactive power value of 50VAr.

9.6.6. MEAS:PF

With this command the power factor value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:PF?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:pf?
```

Return:

```
0.75
```

This query returns power factor 0.75.

9.6.7. MEAS:UP

With this command the voltage peak value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:UP?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:up?
```

Return:

```
325.000
```

This query returns a voltage value of 325p.

9.6.8. MEAS:IP

With this command the current peak value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:IP?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:ip?
```

Return:

```
70.000
```

This query returns a current value of 70Ap.

9.6.9. MEAS:CFU

With this command the voltage crest-factor value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:CFU?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:cfu?
```

Return:

```
1.41
```

This query returns a crest factor of 1.41.

9.6.10. MEAS:CFI

With this command the current crest-factor value can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:CFI?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:cfi?
```

Return:

```
1.75
```

This query returns a crest factor of 1.75.

9.6.11. MEAS:FREQuency

With this command the frequency value of the voltage can be queried.
Execution time: approx. 200ms for the first query; 20 ms for the following queries
Default value = None

Group
Measurement
Syntax

MEAS:FREQuency?

Arguments
Query only
Return
<FLOAT1>
Example

```
meas:frequency?
```

Return:

```
50.000
```

This query returns a frequency value of 50Hz.

9.6.12. Conf:Meas:Mode

This command selects the current measurement mode (coupling).
Execution time: approx. 200ms
Default value = AC

The input of the measurement card is equipped with a coupling capacitor which is bridged in ACDC and DC mode but not in AC mode.

Group
Measurement

Syntax

Conf:Meas:Mode:{ AC | DC | ACDC }

Arguments
AC switches to AC measurement mode for voltage and current

DC switches to DC measurement mode for voltage and current

ACDC switches to ACDC measurement mode for voltage and current

Return
--

Example

```
conf:meas:mode:acdc
```

This command switches to mixed signal measurement (AC and DC) for voltage and current.

9.6.13. Conf:Meas:PH

This command selects the current measurement phase.
Execution time: approx. 200ms
Default value = 1

If you have got several measurement inputs you can route the input pair (U/I) to the input pair of the measurement card.

Group
Measurement

Syntax

Conf:Meas:PH <INT1>

Conf:Meas:PH?

Arguments
<INT1> no. of measurement phase.

Range: 1 ... 3

Return
<INT1>

Example

```
conf:meas:ph 1
```

This example switches the current measurement phase to phase 1.

9.6.14. Meas:Use

This command selects the currently active measurement card
Execution time : approx. 200ms
Default value = 1

If you have got several measurement cards installed in your system you can select the currently active card with this command. All the following settings and queries are related to this card until you select a different one.

Group
Measurement

Syntax

Meas:Use <INT1>

Meas:Use?

Arguments
<INT1> no. of the measurement card

Range: 1 ... 2

Return
<INT1>

Examples

```
meas:use 1
meas:voltage?
```

This command selects measurement card 1 and queries the currently measured voltage.

```
meas:use 2
meas:voltage?
```

This command selects measurement card 2 and queries the currently measured voltage.

9.7. Control

The control subsystem is structured as follows:

Conf
    :Amp
        :Range
Status
    :Amp
AMP
    :Output
    :Range
    :Mode
    :ON
    :Power
    :Pulse
    :Par
    :Q
IMP
    :Phase
    :Range
    :Mode
    :Harm
        :Range
INRush
    :Current
        :Source
Status
    :Curr
CURR
    :Limitation
        :Control
        :Mode
        :Level

9.7.1. AMP:Output

This command switches the amplifier output.
Execution time: max. 2s
Default value=0

Group
Amplifier
Syntax

AMP:Output { 0 | 1 }

AMP:Output?

Arguments
0 switches the output off
1 switches the output on
Return
0 or 1

Example

```
amp:output 1
```

This example switches the output on.

9.7.2. AMP:Range

This command selects the amplifier range. When the amplifier range is changed the output and the control are reset.
Execution time: min. 2s (depends on type of amplifier)
Default value = lowest range which is higher than 230V

Group
Amplifier
Syntax

AMP:Range <INT1>

AMP:Range?

Arguments
<INT1> range number
Return
<INT1>

Example

```
amp:range 1
```

This command switches the amplifier range to range 1.

9.7.3. AMP:Mode

This command switches the amplifiers input mode.
Execution time: approx. 50ms
Default value = AC

Group
Amplifier
Syntax

AMP:Mode:{ AC | DC }

Arguments
AC switches to AC mode
DC switches to DC mode
Return
--

Example

```
amp:mode:dc
```

This command switches the amplifier to DC mode.

9.7.4. AMP:ON

This command switches the amplifier on or off.
Execution time: approx. 500ms
Default value = 1

This command can be used to switch on the amplifier after a security switch off.

Group
Amplifier
Syntax

AMP:ON { 0 | 1 }

AMP:ON?

Arguments
0 switches the amplifier off
1 switches the amplifier on
Return
0 or 1

Example

```
amp:on 1
```

This command switches the amplifier on.

9.7.5. AMP:Power

This command switches the amplifier on or off.
Execution time: approx. 500ms
Default value = 1

This command can be used to switch on the amplifier after a security switch off.

Group
Amplifier
Syntax

AMP:Power { 0 | 1 }

AMP:Power?

Arguments
0 switches the amplifier off
1 switches the amplifier on
Return
0 or 1

Example

```
amp:power 1
```

This command switches the amplifier on.

Reference: This command is similar to the command AMP:ON (section 9.7.4)

9.7.6. Conf:Amp:Range

This command defines the amplifier range value.
Execution time: approx. 20ms
Default value = depends on the hardware

Group
Amplifier
Syntax

Conf:Amp:Range <INT1>,<FLOAT1><LABEL1>

Conf:Amp:Range?

Arguments
<INT1> is the range number
<FLOAT1> is the range end value
<LABEL1> is the dimension of the range value.

Possible values: V / A / %.

Return
Range limit value of the inividual values
Examples

```
conf:amp:range 1,270V
```

This command adjusts a range value of 270V for range 1.

9.7.7. AMP:Pulse

The power supply of the amplifier can be switched to pulse operating voltage (if available).
Execution time: ca. 20ms
Default= 0

Group
Amplifier
Syntax

AMP:Pulse { 0 | 1 }

AMP:Pulse?

Arguments
0 switches off the pulse operation.
1 switches on the pulse operation.

Return
0 or 1
Examples

```
amp:pulse 1
```

The pulse operation is switched on.

The pulse operation has to be reset manually. Although the amplifier switches off the pulse operation automatically after approx. 2 seconds voltage distortions are possible. In any case a waiting period (a few seconds) is recommended to avoid overheating of the power supply.

9.7.8. AMP:PAR

The amplifier can be switched to parallel operation (if available).
Execution time: approx. 10sec (we recommend a 15 sec waiting period)
Default value=0

Reference: **If you want to switch between both parallel modes you first have to switch-off the parallel operation (AMP:PAR 0).**

Group
Amplifier

Syntax

AMP:PAR { 0 | 1 | 2 | 3 }

AMP:PAR?

Arguments
0 Switching off the parallel operation.
1 Switching off the parallel operation (conterminously to 0)
2 Parallel switching of amplifier 1 and amplifier 2
3 Parallel switching of amplifier1, amplifier 2 and amplifier 3

Return
<INT1> is the mode (0 ... 3)

Examples

```
amp:par 2
```

The amplifiers 1 and 2 are connected in parallel.

9.7.9. Status:Amp

This command queries the amplifier status.
Execution time: approx. 20ms
Default value = None

Group
Amplifier
Syntax

Status:Amp?

Arguments
Return
<INT1> is the current status

Possible values:

16 = the amplifier has switched off

Examples

```
Status:Amp?
```

Return:

```
16
```

This query returns the status Byte 16, the amplifier has switched off.

9.7.10. AMP:USE

This command selects the active amplifier that means the subsequent commands refer to the selected amplifier only. This command is only available for systems with more than one amplifier and the corresponding option.
Execution time: approx. 20ms
Default value= 0 (corresponds to „all“)

Group
Amplifier

Syntax

AMP:USE { 0 | 1 | 2 | 3 }

AMP:USE?

Arguments
0 corresponds to „all“ (all amplifiers are addressed)
1 the subsequent commands refer to amplifier 1
2 the subsequent commands refer to amplifier 2
3 the subsequent commands refer to amplifier 3

Return
<INT 1>

1 = Amplifier 1
2 = Amplifier 2
3 = Amplifier 3
4 = Amplifier 4
5 = All amplifiers are addressed

Examples

`amp:range 1`	All amplifiers are set to range 1.
`amp:use 1`	Amplifier 1 is selected.
`amp:range 0`	Amplifier 1 is set to range 2.
`amp:use 0`	All amplifiers are addressed.

9.7.11. AMP:Quadrants

This command switches between 2- and 4-quadrant operation .

The 2-quadrant mode enables only positive voltages (> +20V typ.). The advantage of the 2-quadrant mode compared to the 4-quadrant mode is the significantly lower power dissipation in DC sink mode.

Reference: **During DC recuperation the amplifier has to be set to the 2-quadrant mode.**

Execution time: approx. 2.5s (depends on amplifier type)

Default = 4 (4-quadrant mode)

Group
Amplifier

Syntax

AMP:Quadrants { 2 | 4 }

AMP:Quadrants?

Argumente
2 switches to 2-quadrant mode.
4 switches to 4-quadrant mode.

Return
2 or 4

Example

```
amp:q 4
```

The 4-quadranten mode is switched on.

9.7.12. IMP:Phase

This command selects the measurement phase of the line impedance simulating network (if available).
Execution time: approx. 200ms
Default value = 0

Group
Impedance
Syntax
IMP:Phase { 0 | 1 | 2 | 3 }
Arguments
0 switch to neutral phase
1 switch to phase L1
2 switch to phase L2
3 switch to phase L3
Return
--
Example

```
imp:phase 3
```

This command switches the measurement to phase 3.

9.7.13. IMP:Range

This command switches the range of the line impedance simulating network (if available).
Execution time: approx. 200ms
Default value = LOW

Group
Impedance
Syntax
IMP:Range { "LOW" | "HIGH" }
Arguments
"LOW" switch to 16A range
"HIGH" switch to high current range (e.g. 32A)
Return
--
Examples

```
imp:range "HIGH"
```

This command switches the impedance to high current mode.

9.7.14. IMP:Mode

This command switches the mode of the line impedance simulating network (if available).
Execution time: approx. 200ms
Default value = DIRECT

Group
Impedance
Syntax

IMP:Mode { "HARM" | "FLICK" | "HARMIMP" | "DIRECT" | "NONE" }

IMP:Mode?

Arguments

"HARM"	switch to harmonics mode (impedance off)
"FLICK"	switch to flicker mode (impedance on)
"HARMIMP"	switch to harmonics mode with impedance switched on
"DIRECT"	switch to direct mode (no measurement)
"NONE"	switch to no mode (no measurement)

Return
Adjusted operation mode
Examples

```
imp:mode "HARM"
```

This command sets the impedance to harmonics measurement mode.

9.7.15. IMP:Harm:Range

This command switches the harmonics measurement range of the line impedance simulating network (if available).
Execution time: approx. 200ms
Default value = 1

Group
Impedance
Syntax
IMP:Harm:Range { 1 | 2 | 3 | 4 | 5 | 6 }
Arguments
1 switch to 20A range
2 switch to 4A range
3 switch to 0.8A range
4 switch to 0.16A range
5 switch to 32A range
6 switch to 63A range
Return
--
Examples
```
imp:harm:range 1
```
This command switches the harmonic measurement of the impedance to the 20A range.

9.7.16. INRush:Current:Source

This command switches the Inrush Current Source (if available).
Execution time: approx. 200ms
Default value = 0

Group
Inrush Current Source
Syntax
INRush:Current:Source { 0 | 1 }
INRush:Current:Source?
Arguments
0 switch off the Inrush Current Source
1 switch on the Inrush Current Source
Return
0 or 1
Examples
```
inrush:current:souce 1
```
This command switches on the inrush current source.

9.7.17. CURR:Limitation:Control

This command switches the current limitation (if available).
Execution time: approx. 20ms
Default value = 0

Group
Current limitation
Syntax

CURR:Limitation:Control { 0 | 1 }

CURR:Limitation:Control?

Arguments
0 switch off the current limitation
1 switch on the current limitation
Return
0 or 1

Examples

```
curr:limitation:control 1
```

This command switches the current limitation on.

9.7.18. CURR:Limitation:Mode

This command selects the limitation mode of the current control (if available).
Execution time: approx. 20ms
Default value = LIM

Group
Current limitation
Syntax

CURR:Limitation:Mode { "LIM" | "SWI" }

CURR:Limitation:Mode?

Arguments
"LIM" switch to limiting mode

"SWI" switch to switch off mode

Return
Adjusted operation mode

Examples

```
curr:limitation:mode "SWI"
```

This command switches the current limitation to switching off mode.

9.7.19. CURR:Limitation:Level

With this command the current value of the current limitation can be adjusted (if available).
Execution time: approx. 20ms
Default value = 15

Group
Current limitation
Syntax

CURR:Limitation:Level <INT1>,<FLOAT1>

CURR:Limitation:Level <INT1>?

Arguments
<INT1> is the phase number.

Phase: 1-3.

<FLOAT1> is the current value.
Range: 0-15.
Resolution: 8bit.
Return
<FLOAT1>

Example

```
curr:limitation:level 1,5
```

With this command the current value is adjusted to 5A in phase 1.

9.7.20. Status:Curr

With this command the status of the current limitation can be queried (if available).
Execution time: ca. 20ms
Default value = none

Group
Current limitation
Syntax

Status:Curr?

Arguments
Return
<INT1> is the status.
Range:
1 = current limitation has new status.
2 = current limitation has limited.
4 = current limitation has switched off.

Examples

```
Status:Curr?
```

Return:

```
4
```

This query returns a status of 4; that means, the current limitation has switched off.

9.7.21. RNW:RI

With this command the internal resistance can be adjusted (if available) .
Execution time: approx. 50ms
Default value=none

Group
RNW

Syntax
RNW:RI <FLOAT1>
RNW:RI?

Arguments
<FLOAT1> is the internal resistance which is switched when the amplitude pulse or the PCL is output.

Range:

0.5 ... 8 Ohm

Return
<FLOAT1> Adjusted resistance in Ohm

Examples

```
rne:ri 1
```

9.7.22. RNW:Mode

With this command the operation mode of the internal resistance of the amplifier can be adjusted (if available).
Execution time: approx. 50ms
Default value=none

Group
RNW

Syntax
RNW:Mode <STRING1>
RNW:Mode?

Arguments
<STRING1> is the operation mode of the internal resistance

Range:

“DIR“ Internal resistance is not switched on when the amplitude pulse or the PCL is output.

“P5“ Internal resistance is switched on when the amplitude pulse or the PCL is output.

Return
Mode-String

Examples

```
rnw:mode "p5"
```

9.7.23. RLoad:Load

With this command the resistor load can be adjusted (if available).

Execution time: approx. 200ms

Default value=0W

Group
RLoad

Syntax
RLoad:Load <FLOAT1>
RLoad:Load?

Arguments
<FLOAT1> is the power of the switched-on resistors referring to 230V.

Range:

0 ... 4000W (internally rounded to 1000W)

Return
<FLOAT1> Adjusted power in Watt

Examples

```
rload:load 2100
```

The power of the load resistor is adjusted to 2000W (corresponds to approx. 26.5 Ohm).

```
rload:load?
```

Return:

```
2000W
```

9.8. Input-/Output Port (optional)

9.8.1. Status:Sps

With this command the outputs can be adjusted and the inputs at the socket SPS can be interrogated.

The output OUT1 is engaged for the oscilloscop trigger (see section9.8.2). The inputs IN1 and IN2 are engaged as trigger inputs. For releasing the input trigger the respective pin has to be pulled to GND.

Group
Syntax

Status:Sps <INT1>,<INT2>

Status:Sps <INT1>?

Arguments
<INT1> is the number of the port

1 = output port

2 = Input port

<INT2> is the bit value

1 = 1 Output (Pin 1 is engaged for the oscilloscope trigger)

2 = 2 Output (Pin 2)

4 = 3 Output (Pin 3)

8 = 4 Output (Pin 4)

16 = 5 Output (Pin 5)

32 = 6 Output (Pin 6)

64 = 7 Output (Pin 7)

128 = 8 Output (Pin 8)

Return
<INT1>

1	=	1	input (Pin 9) is connected to GND (Pin 25) (break-trigger)
2	=	2	input (Pin 10) is connected to (Pin 25) (start/stop-trigger)
4	=	3	input (Pin 11) is connected to (Pin 25)
8	=	4	input (Pin 12) is connected to (Pin 25)
16	=	5	input (Pin 13) is connected to (Pin 25)
32	=	6	input (Pin 14) is connected to (Pin 25)
64	=	7	input (Pin 15) is connected to (Pin 25)
128	=	8	input (Pin 16) is connected to (Pin 25)

Example

```
status:sps 1,128
```

The 8. output is connected to GND.

```
status:sps 2?
```

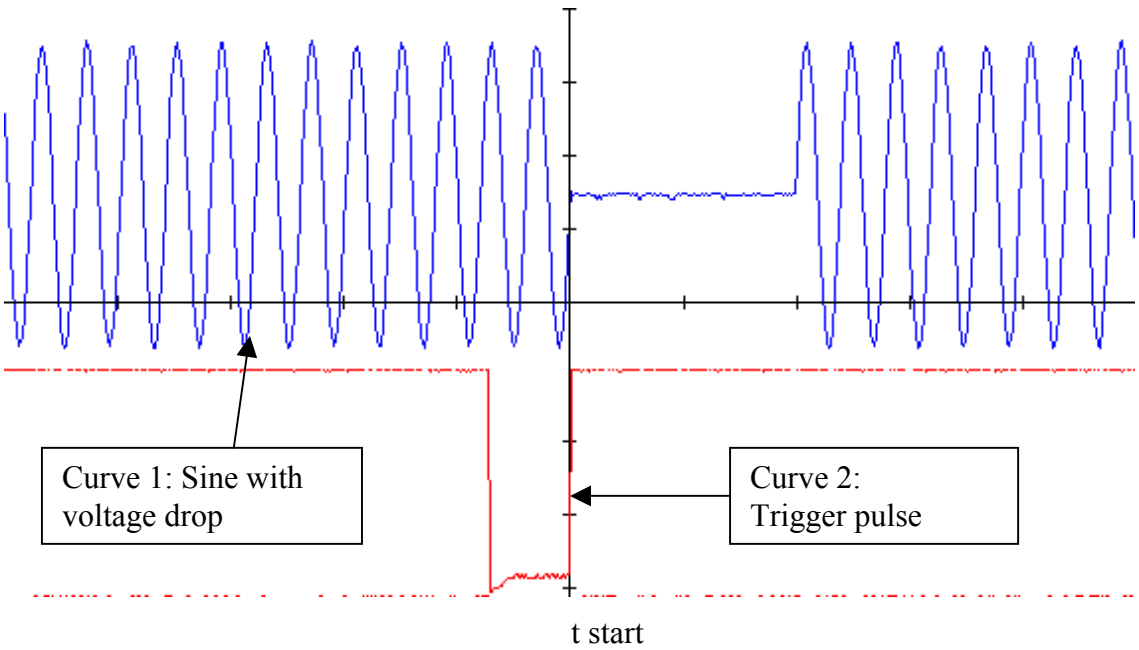
Return:

```
1
```

The first input is connected to GND.

9.8.2. Event Trigger (Oscilloscope trigger)

This trigger is released automatically by the oscillator at each voltage change (amplitude change). Thereby the trigger signal is set from 5V to 0V for approx. 2 periods (approx. 40ms at 50Hz) via an „open-collector circuit“. At the moment of the amplitude change the voltage is set to 5V again.



This picture shows the curve shape of the oscilloscope trigger.

Pin assignment please see section 10.6.

9.9. Interface

The Interface-sub-system structured as follows:

GTL
DCL
*IDN?
Conf
    :IEeee
        :ADR
DATA
    :SET
    :SIZE
    :POINTER
    :WRITE

9.9.1. GTL

This command switches the device back to local mode.
Execution time: ca. 20ms
Default value = none

You can switch back from remote control to local mode.

Group
Interface
Syntax

GTL

Arguments
Return
Example

```
GTL
```

With this command you can switch back from remote control to local control.

9.9.2. DCL

This command resets the device to its default settings.
Verarbeitungszeit: ca. 1s
Default value = none

Group
Interface
Syntax

DCL

Arguments
Return
Examples

```
GTL
```

This command resets the device to its default settings.

9.9.3. *IDN?

This command queries the identification (type of device, number of version)
Execution time: approx. 20ms
Default value = none

Group
Interface
Syntax

*IDN?

Arguments
Return
<String>
Examples

```
*IDN?
```

Return:

```
SPS SyCore V1.01.000
```

This query returns a identification of SPS SyCoreV1.01.000.

9.9.4. Conf:IEee:ADR

This command adjusts the device address.
Execution time: approx. 20ms
Default value = 6

Group
Interface
Syntax

Conf:IEee:ADR <INT1>

Arguments
<INT1> is the device address
Range: 0-31.
Return
--

Examples

```
conf:ieee:adr 6
```

With this command the device address is adjusted to 6.

9.9.5. IEEE Binary Transfer

The IEEE binary transfer is required to transfer specific data e.g. for the oscillator (waveform) . (Examples: please see section 9.5.17; Example 2 or 9.9.5.5)

9.9.5.1. DATA:SET

This command is required for the switching to the binary mode.
Execution time: approx. 20ms

After switching to the binary mode data in the range 0 ... 255 can be transferred. When an EOI (End or Identify) is set or the number of the transferred data is equal to the binary data size (DATA:SIZE) the normal data mode is set.

Group
Interface
Syntax

Syntax : DATA:SET

Arguments
Return
--

Examples

```
DATA:SET
```

This command switches to the binary mode.

9.9.5.2. DATA:SIZE

This command is required for the adjustment of the binary data size.
Execution time: approx. 20ms

After switching to the binary mode the normal data mode is set when the number of the transferred bytes is equal to the binary data size.

Note: 2 Byte are required for each amplitude point.

Group
Interface
Syntax

Syntax : DATA:SIZE <INT1>

Syntax : DATA:SIZE?

Arguments
<INT1> is the binary data size.
Range: 1-2097152(2^20*2).
Return
<INT1>

Example

```
DATA:SIZE 2048
```

The binary data size 2048 is adjusted.

9.9.5.3. DATA:POINTER

This command is required for the adjustment of the destination pointer or the source pointer of the binary data. The address of the memory range of oscillator cards >1kB can be calculated according to the following formula:
Address = (Phase number – 1) * total memory of the oscillator card / 4
For 1kB oscillators always the address 0 is used.

Execution time: approx. 20ms

Group
Interface
Syntax

Syntax : DATA:POINTER <INT1>,<INT2>

Arguments
<INT1> is the segment address
Range: 1 = Oscillator memory
<INT2> is the offset address
Range: 0-2097151(2^20*2).
Return
--

Example

```
DATA:POINTER 1,0
```

With this command the segment address is adjusted to the oscillator and the offset address to Page 0.

9.9.5.4. DATA:WRITE

This command is required for the Transfer of the binary date from the IEEE buffer to the destination pointer (DATA:POINTER).

Execution time: approx. 100ms per 1k

Group
Interface
Syntax

Syntax : DATA:WRITE

Arguments
Return
--

Example

```
DATA:WRITE
```

With this command the binary data are transferred from the IEEE buffer to the destination pointer.

9.9.5.5. Example

Example for transferring a waveform with memory depth 1kB (1024 points with 16bit each (2 Byte)) to phase 1 of the oscillator.

```
1.    D:PO 1,0
2.    D:SI 2048
3.    D:SE
4.    transfer of the values with binary transfer command ( transmitarray ( ) o.ä. )
5.    D:WR
```

Explanation:

1. The destination address in the oscillator memory is set; address 0 stands for the address of the memory range of the first phase. The address of the memory range of other phases (for oscillator cards >1kB) can be calculated according to the following formula:
   Address = (Phase number – 1) * total memory of the oscillator card / 4
   For 1kB oscillators always the address 0 is used.
2. The size of the data block to be transmitted is set.
3. Switching to binary mode.
4. Transmitting of the values (function made available by the driver of the interface card).
5. Copying of the transmitted data into the oscillator memory.

Note: Data blocks >64kB must be dissected in blocks < 64kB; repeat point 1 to 5 (the address has to be increased correspondingly).

10. Pin Assignment

10.1. Link In/Out

This interface is only available with firmware version < V2.0.

Pin	Labelling
1	LinkOut0
2	LinkIn0
3	LinkOut1
4	LinkIn1
5	LinkOut2
6	LinkIn2
7	LinkOut3
8	LinkIn3
9	ErrorIn
10	ResetOut
11	ErrorOut
12	Analyse
13	ResetIn
14	GND
15	GND
16	GND
17	GND
18	GND
19	GND
20	GND
21	GND
22	GND
23	BFR
24	+5V
25	+5V

10.2. IEEE488

Pin	Labelling
1	DIO1
2	DIO2
3	DIO3
4	DIO4
5	EOI (end or identify)
6	DAV (data valid)
7	NRFD (not ready for data)
8	NDAC (not data accepted)
9	IFC (interface clear)
10	SRQ (service request)
11	ATN (attention)
12	SHIELD
13	DIO5
14	DIO6
15	DIO7
16	DIO8
17	REN (remote enable)
18	GND (TW PAIR W/DAV)
19	GND (TW PAIR W/NRFD)
20	GND (TW PAIR W/NDAC)
21	GND (TW PAIR W/IFC)
22	GND (TW PAIR W/SRQ)
23	GND (TW PAIR W/ATN)
24	SIGNAL GROUND
25	

10.3. Control

Pin	Labelling	
1		Remote (obsolete)
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		Overload
13		
14		Release
15		A – RS485
16		B – RS485
17		
18		
19		
20		
21		
22		
23		+24V Control voltage
24		
25	GND	Control ground

10.4. Analog I/O

Pin	Labelling	
1	Osc -	
2	Osc +	
3	U-Meas -	
4	U-Meas +	
5	I-Meas -	
6	I-Meas +	
7	U-Mon -	obsolete
8	U-Mon +	obsolete
9	I-Mon -	obsolete
10	I-Mon +	obsolete
11		
12		
13		
14	Osc shield	obsolete
15		
16	U-Mess shield	obsolete
17		
18	I-Mess shield	obsolete
19		
20	U-Mon shield	obsolete
21		
22	I-Mon shield	obsolete
23	DOUT1	only when R_i is adjustable
24	+5V	only when R_i is adjustable
25	GND	only when R_i is adjustable

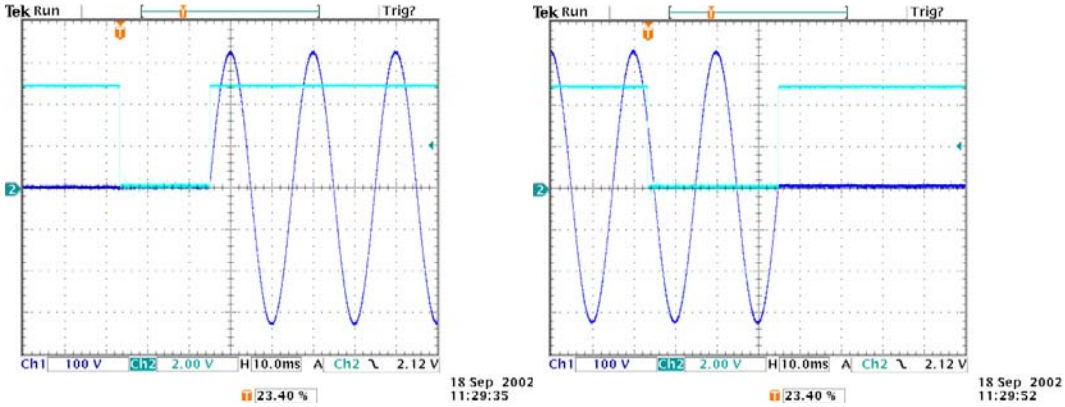
10.5. RU_Control

Pin	Labelling
1	N
2	
3	c.l. mains
4	
5	
6	
7	PE

10.6. Digital I/O (Event Trigger)

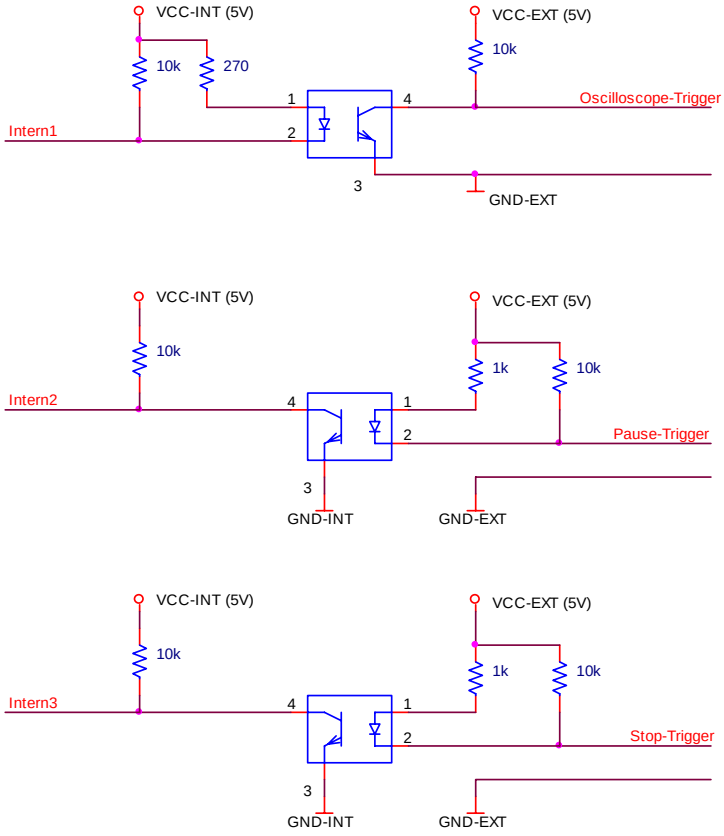
Pin	Labelling	
1	OUT1	Trigger output oscilloscope +5V
2	OUT2	
3	OUT3	
4	OUT4	
5	OUT5	
6	OUT6	
7	OUT7	
8	OUT8	
9	IN1	Trigger input 1 (Pause)
10	IN2	Trigger input 2 (Stop)
11	IN3	
12	IN4	
13	IN5	
14	IN6	
15	IN7	
16	IN8	
17		
18		
19		
20		
21		
22		
23		
24		
25	GND	GND

10.6.1. Oscilloscope Trigger and Trigger Input



The oscilloscope trigger will only be released when voltage and frequency adjustments are made at oscillator 1. When voltage and frequency are adjusted at oscillator 2 oscilloscope trigger is not released. .

Note: VCC-EXT is galvanical isolated from the internal side. But the GND-EXT may be earthed if an oscilloscope is connected to the oscilloscope trigger. Even if the scope is not connected to earth directly it may be earthed via the IEEE488 interface !



Schematic diagram of trigger output and trigger inputs

10.6.2. "Extern Output Switch" (optional)

The option „Extern Output Switch" enables the switching of the amplifier output by an externally connected switch contact. For this, a switch contact has to be connected between contact 11 and 24 at the socket "DIGITAL I/O". The output is switched at each contacting (on/off).

11. Technical Data

11.1. Oscillator

Technical Data

Number of phases: 1, 2 ,4 or n

Wave forms:

Internal: sine, triangle, rectangle, saw-tooth, pulse, DC

External: free programmable signal shapes
in connection with the software package “SignalManager”

Input impedance
“EXT. INPUT”: approx. 10kΩ

Memory:

Horizontal resolution 256; 1024; 4096; 16384; 65536; 1048576 points

Vertical resolution ± 32768 points / 16 bit (1.024 points)

Output: $3{,}53V_{rms}$ / $10V_{pp}$

Amplitude resolution: 0.01%

Voltage accuracy: $< 1 \times 10^{-3}$ / < 0,1% (10 ... 100% modulation)

Voltage stability: $< 2 \times 10^{-4}$ - 10min
$< 1 \times 10^{-3}$ - 24h

Output impedance: approx. 50Ω

Offset: < 1mV

Frequency:

Phase number	Memory depth [B]	Max-Frequency [Hz]	Frequency resolution = Min.-Frequency [Hz]
1	256	39062.50	0.298023
1	1024	9765.62	0.074506
1	4096	2441.40	0.018626
1	16384	610.35	0.004657
2	256	19531.25	0.149012
2	1024	4882.81	0.037253
2	4096	1220.70	0.009313
2	16384	305.18	0.002328
4	256	9765.62	0.074506
4	1024	2441.40	0.018626
4	4096	610.35	0.004657
4	16384	152.59	0.001164
1	256 (2 Periods)	78131.00	0.596046
1	256 (4 Periods)	156262.00	1.192092

Frequency accuracy: please see table “frequency resolution”

Frequency stability: $< 2 \times 10^{-5}$

Sampling frequency: max. 10MHz

11.2. Multiplier

Voltage input:	max. $5V_p$
Frequency range:	DC … 100Hz
Multiplication error:	±2% DC; ±10% AC

11.3. Measurement

Voltage input

Measuring range:	300V
max. voltage:	$500V_p$ and/or 500V DC
Frequency range:	DC; 15Hz ... 5kHz
Measuring error (AC): (30V...300V)	15Hz ... 40Hz: ±2% of measured value ±3digit 40Hz ... 450Hz: ±0.5% of measured value ±3digit 450Hz ... 5kHz: ±1% of measured value ±3digit
Measuring error (DC):	±0.3% of measured value ±3 digit (30V...300V)
Indication:	5 digit, 99999 digit
Impedance:	1MΩ

Current input

Amplifier type:	PAS1k	PAS2k	PAS2k5	PAS5k	PAS7k5
Meauring range:	20A	40A	40A	100A	150A
Amplifier type:	PAS10k	PAS15k	PAS20k	PAS25k	PAS30k
Meauring range:	200A	300A	400A	450A	500A

Frequency range:	DC; 15Hz ... 5kHz
Measuring error (AC): (10%…100% of measured range)	Measurement with Shunt (when using amplifier type PAS 1000, PAS 2000, PAS2500 and Automotive Systems) 15Hz ... 40Hz: ±2% of measured value ±30 digit 40Hz ... 450Hz: ±0.5% of measured value ±30 digit 450Hz ... 5kHz: ±1.6% of measured value ±30 digit Measurement with LEM-module (when using amplifiers ≥ PAS 5000; exception: Automotive systems always with Shunt-measurement) 15Hz ... 40Hz: ±2% of measured value ±30 digit 40Hz ... 450Hz: ±0.5% of measured value ±30 digit 450Hz ... 2kHz: ±2% of measured value ±30 digit 2kHz ... 5kHz: ±5% of measured value ±30 digit
Measuring error (DC): (10%…100% of measured range)	±0.5% of measured value ±30 digit
Indication:	5 digit, 99999 digit

Power (P; Q; S)

Measuring error (AC): Measurement with Shunt
(when using amplifier type PAS 1000, PAS 2000, PAS 2500 and Automotive Systems)

15Hz ... 40Hz:	±3%	of measured value	±50digit
40Hz ... 450Hz:	±1%	of measured value	±50digit
450Hz ... 5kHz:	±2.5%	of measured value	±50digit

Measurement with LEM-module
(when using amplifiers ≥ PAS 5000;
exception: Automotive systems always with Shunt-measurement)

15Hz ... 40Hz:	±3%	of measured value	±50digit
40Hz ... 450Hz:	±1%	of measured value	±50digit
450Hz ... 2kHz:	±2.5%	of measured value	±50digit
2kHz ... 5kHz:	±6%	of measured value	±50digit

Measuring error (DC): ±1% of measured value ±50digit
(10%...100% of measured range)

Power factor (PF)

Measuring error: ±0.1
(10%...100% of measured range)

Peak value (U_p, I_p) technical data see voltage/current measurement

Crest factor (CF_U, CF_I)

Measuring error: ±0.3
(10%...100% of measured range)

Frequency

Frequency range: f_{Meas} = 3Hz ... 20kHz

Reference frequency: f_{Ref} = 10MHz

Measuring error: $\frac{fMess}{f\,Re\,f} \cdot 100$ = error in %

for f =50Hz $\Rightarrow$ 0.1% error

Oscilloscope

Signal representation: 0Hz ... 2kHz

Time base: 0.5ms ... 2s

Vertical deflection: voltage channel (CH1): 1V, 2V, 5V, 10V, 20V, 50V, 100V,200V, 5000V

current channel (CH2): 1A, 2A, 10A, 20A, 50A

Trigger: Trigger level

+/- edge triggering

Trigger channel: CH1 or CH2

Phase angle: 0° to 360° (referring to the pseudo phase)

Angle resolution:

Memory Depth [points]	Angle resolution [°]	Angle accuracy [°]
256	1.41	2
1.024	0.35	0.5
4.096	0.09	0.2
16.384	0.02	0.05

Reference: When the SyCore is integrated in a three-phase system (e.g. DM 15000/PAS) the angular error of the complete system increases (e.g. max. ±1° at 1024 points memory depth).

Trigger: 0° to 360°

Angle resolution: please see table "phase angle"

11.4. General

Interface: IEEE-488 (Listener-Talker)

Mains supply: 230V_{rms} (±10%) 50/60Hz

Ambient temperature: 0°C to +40°C

Housing: colour: light grey (RAL 7035)

19"-plug-in-unit (3U) approx. H=135mm; B=483mm; T=450mm

Desk-top-casing (3U) approx. H=180mm; B=540mm; T=550mm

Weight: approx. 10kg

12. Index

*****

*IDN? 126

+

+ Angle 12

2

2-quadrant operation 113

4

4-quadrant operation 113

A

AC Mode 108
Active Amplifier 112
Active Measurement Card 105
Active Power 27
Adder 15, 56
AMP:Mode 108
AMP:ON 108
AMP:Output 107
AMP:PAR 111
AMP:Power 109
AMP:Pulse 110
AMP:Range 107
AMP:USE 112
Amplifier 32, 108, 109
Amplifier Output 32, 107
Amplifier Range 32, 107
Amplifier Range Value 109
Amplifier Selection 38
Amplitude 12, 50, 51, 85
Amplitude Adjustment 30
Amplitude- and Frequency Pulse 18
Amplitude Pulse 18
Angle 12
Angle Resolution 22
Apparent Power 27
Apparent Power Value (Query) 99
Averaging Factor 26

B

Basic Adjustment 11
Basic Functions 12
Binary Data Size 128
Binary Data Transfer 127
Binary Mode 127
BREAK 89

C

Card Selection 15
Channel Selection 30
Command Synchronization 45
Command Syntax 44
Commands 46
Conf:Amp:Range 109
Conf:IEee:ADR 126
Conf:Meas:Mode 103
Conf:Meas:PH 104
Conf:Osc:PHases 58
Content of a List Cell 90
Control 32, 48, 106
Crest-Factor Measurement 25
CURR:Limitation:Control 117
CURR:Limitation:Level 118
CURR:Limitation:Mode 117
Current Crest-Factor Value (Query) 102
Current Limitation 36, 117
Current Limitation Mode 117
Current Peak Value (Query) 101
Current Switch- off Mode 117
Current Value (Query) 98
Cursor Keys 8

D

DATA:POINTER 129
DATA:SET 127
DATA:SIZE 128
DATA:WRITE 129
DC Mode 108
DCL 125
Default 125
Delay Time between Amplitude Pulses 66
Delay Time between Frequency Pulses 76
Destination Pointer 129
Device Address 126
Dialog Window 7
Digital Keys 8
Display 6
Display Contrast 6
Duration of a Frequency Pulse 73

E

Edge Selection 31
Edit Keys 8
End-Amplitude 61
End-Frequency of a Frequency Pulse 71
Enhanced Amplifier Functions 33
Event Trigger 123, 135
External Control 5

F

Fall Time 64
Fall Time of a Frequency Pulse 74
Flicker Mode 115
Frequency 13, 53, 82
Frequency Measurement 29
Frequency Pulse 19
Frequency Value of the Voltage (Query) 103

Front Panel 4
Function Diagram 10
Function Keys 8

G

General Instructions 3
Generation and Query of a Waveform 87
GTL 125

H

Harmonic Range 35
Harmonics Mode 115
High-Frequency AC Voltages 11

I

Identification 126
IEEE Buffer 129
IEEE488 44
IMP:Harm:Range 116
IMP:Mode 115
IMP:Phase 114
IMP:Range 114
Impedance 35
Impedance Harmonics Measurement Range 116
Impedance Measurement Phase 114
Impedance Operation Mode 35
Impedance Phase 35
Impedance Range 35, 114
Incremental Switch 4
Info 43
Input Lines 7
Input-/Output Port 122
Inrush Current Source 116
INRush:Current:Source 116
Interface 44, 48, 124
Interface Address 43
Internal Resistance 33, 120

K

Keys 8

L

LEM-module 139, 140
List Cell 83
Local Control 125
Low-Frequency AC Voltages 11

M

Macros 40
Mains Supply 141
Mains Synchronous 14, 55
MEAS:CFI 102
MEAS:CFU 102
MEAS:CURRent 98
MEAS:FREQuency 103
MEAS:IP 101
MEAS:PF 100
MEAS:POWer 99
MEAS:Q 100
MEAS:S 99
MEAS:UP 101
Meas:Use 105
MEAS:VOLTage 98
Measurement 23, 47, 97
Measurement Mode 103
Measurement Phase 104
Memory Depth 21, 81, 91
Menu 6
Menu Sequence 6
Menu Tree 9
Multiplier 14, 16, 56, 139

N

Number of Phases 58
Number of Repeats of a Frequency Pulse 75
Number of Repeats of an Amplitude Pulse 65

O

Offset Compensation 25
Operation 6
Operation Mode 32, 33
Options 3
OSC:AddMult 56
OSC:AFPuls:GO 68
OSC:AMPlitude 50, 51
OSC:ANGle 52
OSC:APuls:DElayt 66
OSC:APuls:DURAT 63
OSC:APuls:END 61
OSC:APuls:FALLT 64
OSC:APuls:GO 67
OSC:APuls:PULS 60
OSC:APuls:REpeats 65
OSC:APuls:RISET 62
OSC:APuls:START 59
OSC:FPuls:DElayt 76
OSC:FPuls:DURAT 73
OSC:FPuls:END 71
OSC:FPuls:FALLT 74
OSC:FPuls:GO 77
OSC:FPuls:PULS 70
OSC:FPuls:REpeats 75
OSC:FPuls:RISET 72
OSC:FPuls:START 69
OSC:FREQuency 53
OSC:Page:AMplitude 85
OSC:Page:ANgle 84
OSC:Page:CLear 89
OSC:Page:CYcles 80
OSC:Page:FRequency 82
OSC:Page:FUnction 87
OSC:Page:GO 88
OSC:Page:GOBYtrigger 89
OSC:Page:MEMory 91
OSC:Page:NUmber 83
OSC:Page:PArameter 90

OSC:Page:PEriods 90
OSC:Page:PULS 86
OSC:Page:SIze 81
OSC:Page:STopnumber 88
OSC:Page:TOtalcycles 88
OSC:Page:TRigger 82
OSC:Sync 55
OSC:TRigger 54
OSC:Use 57
Oscillator 11, 46, 49
Oscillator Card 57
Oscilloscope 30
Oscilloscope Trigger 123, 136

P

Page Control List 47, 78
Parallel Connection 34
Parallel Operation 111
PCL Clear 89
PCL Repetitions 88
PCL Run interrupt 89
PCL Run start 88
PCL Run start by trigger 89
PCL Stop 88
Peak Value Measurement 25
Phase Angle 52, 84
Phase Selection 30
Pin Assignment 131
Power Factor 28
Power Factor Value (Query) 100
Power Measurement 27
Power Value (Query) 99
Pulse Amplitude 60
Pulse Duration 63
Pulse Operation 33, 110
Pulse-Frequency of a Frequency Pulse 70

R

r.m.s. - Value Measurement (U/I) 23
Radio Buttons 7
Reactive Power 27
Reactive Power Value (Query) 100
Rear Panel 5
Remote Control 125
Repeats 65, 75, 80
Resistor Load 37, 121
Rise Time 62
Rise Time of a Frequency Pulse 72
RLoad:Load 121
RNW:Mode 120
RNW:RI 120

S

Safety 3
Set-up 43
Shunt 139, 140
Signal Representation 30
Softkeys 6
Source Pointer 129
Special Functions 18
Start Amplitude 59
Start Frequency of a Frequency Pulse 69
Starting of a Frequency Pulse 77
Starting of an Amplitude and Frequency Pulse 68
Starting of an Amplitude Pulse 67
Status 111
Status:Amp 111
Status:Curr 119
Status:Sps 122
Supply 32
Synchronized Amplitude Phases 13
Synchronizing 14, 55

T

Technical Data 138
Time Base 31
Transportation Damage 3
Trigger 14
Trigger Adjustment 30, 31
Trigger Angle 54, 82
Trigger Input 136
Trigger Level 31
Trigger Pulse 123

V

Version Number of the Firmware 43
Voltage Crest-Factor Value (Query) 102
Voltage Peak Value (Query) 101
Voltage Value (Query) 98

W

Waveform 20
Waveform Transfer 127

13. Annex